Current Rail Safety Issues in the US

Jeff Moller
Executive Director Operations
Association of American Railroads
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Scope of the Industry

Type of Railroad	Number	Miles Operated*	Employees	Freight Revenue ($ billions)
Class I	7	97,496	157,699	$39.13
Regional	31	15,641	7,422	1.41
Local Linehaul	314	20,753	5,349	0.98
S&T	204	6,356	6,429	0.64
Canadian**	2	560	n/a	n/a
Total	558	140,806	176,899	$42.16

*Excludes trackage rights. **Includes CN and CP operations that are not part of a CN- or CP-owned Class I carrier. Source: AAR

This table provides an overview of the scope of the United States rail industry. (Two major railroads are owned by Canadian railroads and are shown as Class 1 carriers (greater than $289 million in revenue). These Canadian railroads also own several regional railroads.

Safety Statistics

The industry continues an excellent safety performance – 2005 was the safest year ever in terms of employee on-duty injuries & injury rates (down 7% and 11% from 2004); grade crossing collision rates & injury rates (down 4% and 9% from 2004); and trespasser fatality and injury rates (down 4% from 2004). Based on year to date data 2006 should be even better. The following slides are representative:

Train accidents per million train-miles have dropped 65% since 1980 & 15% since 1990.

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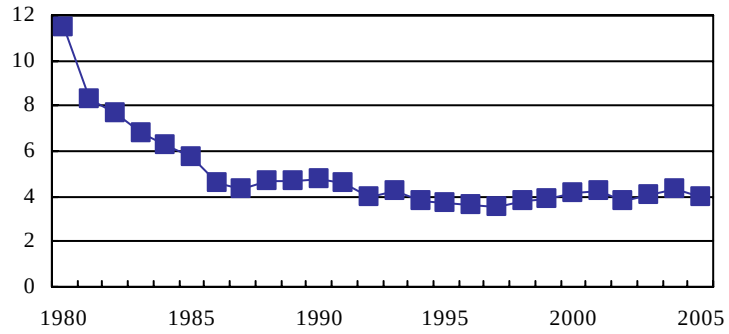
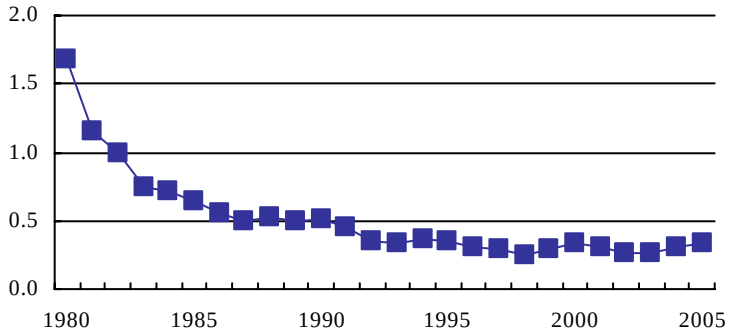


Train collisions per million train-miles have dropped 80% since 1980 & 36% since 1990.



Similar trends can be seen for derailments, equipment and track-caused accidents, fatalities at grade crossings, and to some extent human-factors-caused accidents.

Much of this improvement can be traced to the *Staggers Act* of 1980 which deregulated the industry. Prior to this legislation, more than more than 20 % of the industry had gone into bankruptcy over the previous decade and earnings averaged less than 2% on investment. Deferred maintenance was mounting, accident rates were high and market share was in a downward spiral. The legislation freed up railroads to compete as do other industries and in the ensuing years;

- Productivity tripled.
- Intermodal traffic has almost quadrupled.
- Market share has increased as rates have declined more than 50%, and earnings have improved sharply.
- A third of a trillion dollars in private capital has been invested to maintain and improve tracks, signals, communications systems, freight cars and locomotives.
- Accidents are down by two-thirds.
- Rail service is good enough to meet the just-in-time demands of the auto industry. U.S. freight railroads move more freight than any other rail system in the world.

Passenger Safety Issues

While passenger service in the US does not dominate inter-city travel as it does in many other countries, passenger volumes have steadily climbed and many new regional and commuter operations are starting up or being planned. There are a number of safety initiatives that may be of interest.

The Federal Railroad Administration (FRA) conducts many rulemaking issues under the auspices of the Rail Safety Advisory Committee[1]. A Passenger Safety Working Group has formed several Task Forces and has been at work on several initiatives:

[1] Group includes more than 50 members from FRA, rail management, labor and other interested parties.

Mechanical

One task force reviewed current rules governing the attachment of ladders, hand holds and riding stirrups ("safety appliances") to passenger equipment. A strict reading of the current rule limited advanced designs because it prohibits welding such equipment to the car body.

Crashworthiness / Glazing

A second task force has been exploring updated standards for passenger car design and window glazing standards. Refinements include the strength of collision and corner posts and a new test standard for glazing. This will be discussed in more detail shortly. For glazing, the current "cinder block" impact test is being replaced by a metal sphere test that is less costly to perform and easier to replicate

Emergency Preparedness

This group worked on the size and placement of rescue access / emergency access windows, kick panels, soft spots in roofs for emergency responders, photo luminescent signage and emergency lighting and communication systems.[2] Some items are intended for new construction, other features would be retrofitted to existing equipment. A proposed new rule encompassing these issues was published August 24.

Vehicle / Track Interaction

As new designs are introduced this group is looking at revising the standards and process for qualifying new high speed equipment. This included the elimination of expensive instrumented wheelset testing for moderate and lower speed equipment, revising car body acceleration criteria and consolidating some high speed track standards to make them consistent.

Platform Safety / "2nd Train in Station"

A new group is just getting underway to examine passenger safety issues at station platforms. Issues include possible guidelines for platform gaps (space between coach and platform), signage, warning announcements and construction standards for new stations. For example, when possible, avoid stations on curves where platform gaps need to be wider to accommodate equipment swing. Another issue is safety at ground level platforms where trains may be operating on adjacent tracks.

Additional Discussion about Crashworthiness

Several recent accidents have renewed interest in improving passenger train crashworthiness – especially cab control cars.

February 16, 1996 – Silver Spring, Maryland.

A commuter train in push mode failed to stop at a home signal and struck the corner of the lead locomotive of an opposing passenger train that was crossing over to an adjacent track. The side of the front third of the lead commuter coach is ripped away and burned by a fuel fire originating from the fuel of the opposing train. There were 11 fatalities. Accident investigation findings include emergency evacuation issues.

April 23, 2002 - Placentia, California

A freight train failed to stop at a home signal and collided head on with the cab car of a commuter train in push mode. The step down frame area of one of the bi-level cars buckled and two passengers were fatally-injured. Accident investigation findings include the design of passenger tables (associated with the fatalities).

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[2]Additional information can be found in APTA SS-E-013-99, Rev. 1 - Standard for Emergency Lighting System Design for Passenger Cars

January 26, 2005 – Burbank, CA

A deranged individual drove his Jeep Cherokee away from a crossing, astride the rails near a turnout. An approaching commuter train in push mode struck the vehicle and carried it along to the turnout where the lead truck diverted into the auxiliary track causing the car to collide with a standing locomotive. The rear of the lead coach rotated into the side of second car of another commuter train passing on an adjacent track (in pull mode). The compression force derailed the standing freight locomotive onto its side and derailed the trailing coach of the second train. Ten passengers and one trainman were fatally injured. Accident investigation findings include the crashworthiness of cab control cars.

These three accidents lead to a series of research projects including computer modeling of crash scenarios, full-scale crash testing and pending new design standards. At this point, a discussion of the goals of crashworthiness may be helpful:

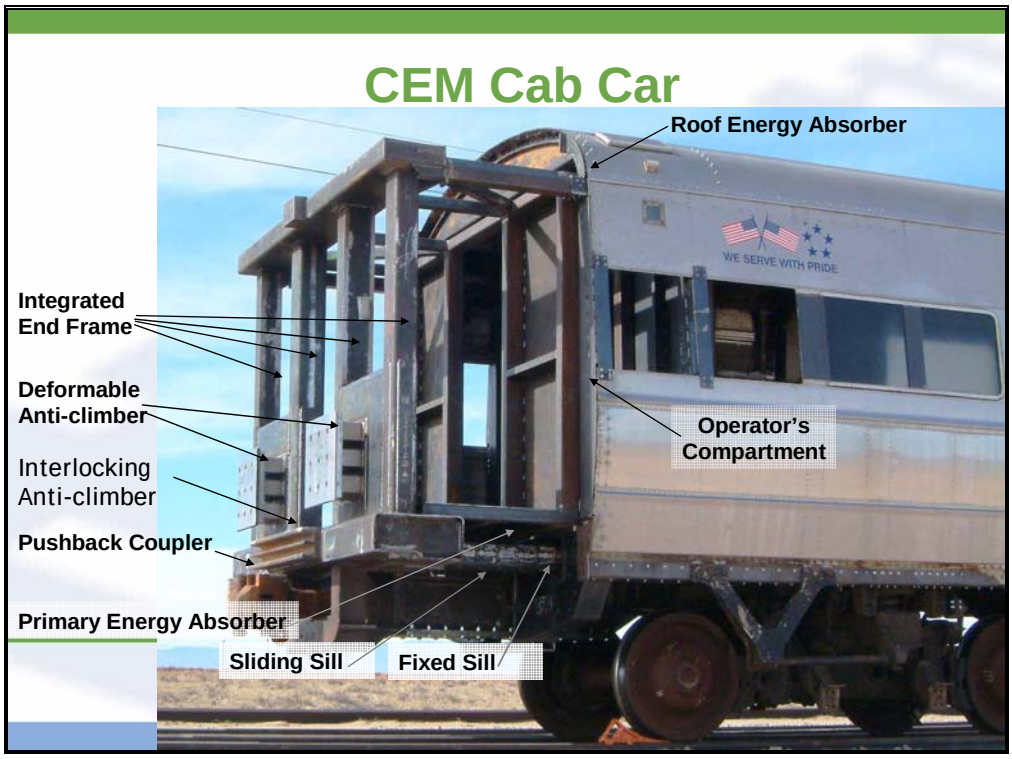
<u>Preserve Occupant Volume</u>

- Maintain Sufficient Space
- Minimize Local Compartment Penetration
- Ensure Occupant Containment

<u>Limit Forces / Decelerations to Survivable Levels</u>

- Limit Deceleration of Occupant Volume
- Keep Secondary Impact Forces within Safe Limits
- Secure Interior Fittings

A series of full-scale crash tests have been conducted at the Transportation Technology Center, Inc. in Pueblo Colorado. This facility is owned by the Federal Government it is operated by the Association of American Railroads. A notable test was conducted in January 2002 when a string of conventional coaches was directed into a standing locomotive at a speed of about 30 mph. The underframe of the lead coach was held in position by the locomotive but the force of the collision sheared the car body away causing it to climb and telescope onto the locomotive. Twenty-two feet of occupiable space in the coach was destroyed and represented the potential for substantial loss of life. A follow-up test was conducted in March 2006 using two trains of similar weight and speed as in the prior test. Here each coach was retrofitted with crash energy management systems (CEM) or crush zones at each end. The major features are strengthened collision and corner posts, which are designed to absorb a considerable amount of energy before sliding back into the car body.



The second test demonstrated the ability of the crash energy management design to incrementally absorb the collision forces and eliminate any crush of the carbody within occupied areas of the car. In the prior test conventional car experienced 22 feet of crush while the CEM-equipped coaches received than 6 feet of crush, all of it within the crush zones.

As a result of this research, a commuter carrier has already placed an order for new CEM-equipped cab cars to replace its existing fleet.

The February 2006 crash test was not confined to a trial of the CEM equipment. Additional research projects inside the coaches tested seating and passenger table designs. Some new designs are promising and additional research is underway. These include a passenger table (very popular with commuters) that that would spread and absorb the force of a passenger being forced into the table edge during an accident. The table is thicker, made up of a crushable aluminum honeycomb and a scored melamine tabletop that is designed to break away harmlessly.

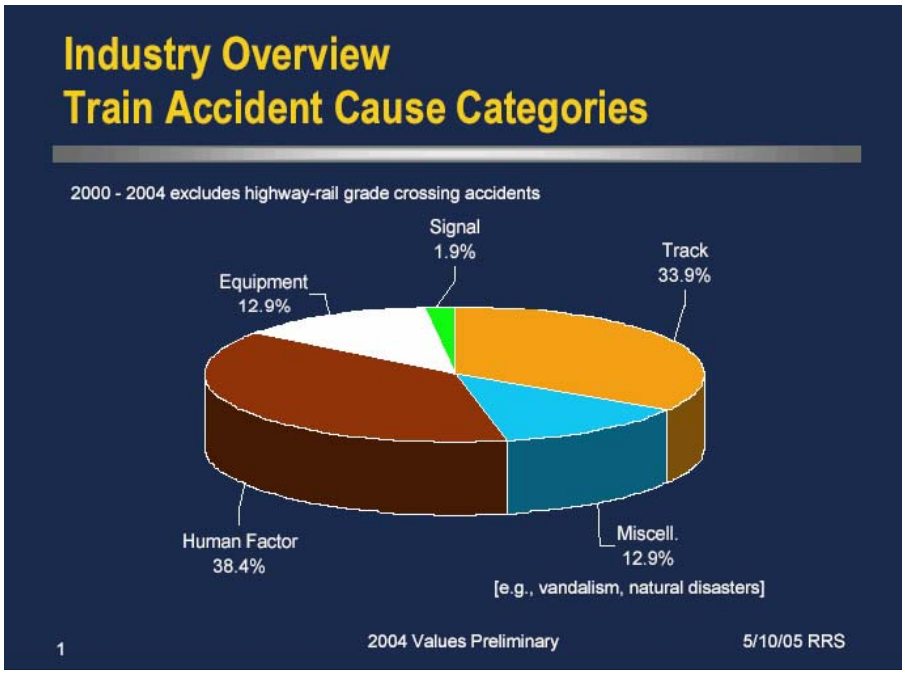
Passenger locomotive crashworthiness is also being progressed. New designs such as the Amtrak *Acela*, a monocoque diesel electric locomotive manufactured by General Electric and a similar design by Boise Locomotive have been in service for a number of years and the latter two designs have fared will in some catastrophic accidents. In September 2005, for example, a Boise locomotive derailed and turned over at 68 mph striking a concrete building. The locomotive cab remained intact and the crew was able to walk away. The locomotive was subsequently repaired and returned to service.[3]

[3] Freight Locomotives have standards as well. All new road-type locomotives built after August 1, 1990, for the US have been built to AAR specification S-580:

- Anticlimbers must sustain an ultimate vertical load of 200,000 lbf at the short hood end
- Collision posts Two, each of which shall sustain an ultimate load of 200,000 lbf at 30 inches above the deck and 500,000 lbf at the deck

Human Factors Issues

In May, 2005 the FRA published a Rail Safety Action Plan noting that as other risk categories are addressed, human error now constitutes the largest category of train accidents, accounting for 38 percent during the last five years.



An analysis of the data showed that almost half of reported human factors accidents fall into three broad categories:

- Misaligned Switches
- Cars Left Within the Fouling Pont of Switches
- Unprotected Shoving Moves

While the majority of these accidents represent low-consequence, low speed switching activity, the errors have to potential for more serious accidents. A Rail Safety Advisory Group was formed to create federal rules governing the three activities and a proposed rule will be issued by the FRA in the next few months.

- Short hood structure The product of skin thickness and yield strength shall be at least 0.5 inches times 25,000 psi

The FRA continues research and newer standards are being established for new production.

Medical Standards

In recent years the National Transportation Safety Board has investigated several accidents in rail and other modes where the operator's physical condition was a contributing factor.

Currently, FRA has hearing and vision requirements for locomotive engineers and soon will issue a rule on hearing requirements for trainmen. In January 2005, the agency published a study examining their current standards and contrasting them with other transportation modes in the US and with railroads in other countries. While individual railroads already had periodic medical examinations and other requirements, the report concluded that there was a need for a consistent industry-wide medical standards program. The report also found that the current program is less comprehensive than those found in other modes and in other countries.

After the release of this report, the industry held a series of meetings in order to devise a proposal to address this issue. The group looked carefully at the Canadian approach where requirements are spelled out in a relatively short document and extensive industry guidelines are included by reference. This document discusses specific conditions and ranges of appropriate treatments. It is administered by a group of physicians from the government, the industry and labor. A major benefit of this approach is that it provides appropriate oversight while providing flexibility by remaining outside the scope of traditionally-slow rulemaking.

On September 21 the Rail Safety Advisory Committee is expected to agree to form a new working group to address new Medical Standards for Safety-Critical Employees. It is expected that employees from the ranks of train and engine crews, signal maintainers and train dispatchers will be included. As of this writing the draft task statement reads as follows:

> Develop proposed FRA standards implementing medical guidelines to provide an industry wide means of determining medical fitness for duty and identifying conditions that could lead to sudden incapacitation or impairment of safety-critical employees.
>
> • Propose the mechanisms for defining and updating the medical guidelines used.
> • Propose the procedures for determining the fitness of individual employees.
> • Describe record keeping and other arrangements to provide an auditable process that protects medical confidentiality.

industry and its employees. Rather than include an exhaustive discussion here, the executive summary of a new paper is included at the end of this memo. The document will be published in a few weeks and the website address will be provided at Dublin.

Confidential Close Call Reporting System

As safety increases (the number of accidents and incidents decline), gathering statistical data and information on system safety issues becomes increasingly challenging. Confidential safety reporting programs such as *CIRAS* have been in existence for years[4] and the industry began talking a look in May 2002 with the formation of an industry planning committee. Representatives of FRA, the Volpe Research Center, labor and management designed and produced a workshop in April 2003 that hosted speakers from aviation and UK's Rail Safety and Standards Board.[5]

The Workshop generated enough interest that the planning committee went ahead to develop a model reporting program and in May 2005 a sample *Memo of Understanding* that a railroad, its employees and the FRA could use to devise a pilot project. Several railroads (and labor representatives) have agreed to consider this approach and the Union Pacific railroad is

[4] The NASA Aviation Safety Reporting System (ASRS), began in April 1976.

[5] For further information, see: http://www.closecallsrail.org/publications_workshop.asp

close to executing a formal agreement governing a pilot test at its terminal in North Platte, NE.[6] Additional information about the reporting system can be found at: http://www.closecallsrail.org

Remote Control Locomotives

Widely used for years in other countries and on US industrial railroads, this technology has only recently been instituted on major US railroads. The FRA held a series of inspections meetings and workshops beginning in March 1992 on a short line railroad. Labor concerns seemed to be the major challenge to utilizing the technology until FRA issued a *Safety Advisory* in February 2001. At that time, major railroads created an informal committee to create a training program in consultation with FRA. In summary, the training program was designed for current train crew personnel to receive 2 weeks of training with about 50% devoted to actual practice with the equipment.

Recently FRA released a safety study of the technology that found it is at least as safe as conventional switching (safer in terms of employee injuries). The report did raise concerns about the possibility of main track operations expressing the view that the technology is not ready for higher speeds or heavier tonnage. The report also expressed concern about training now that so many new employees are entering the industry because of increased traffic and retirements. A labor-management-FRA Task Force is currently studying the issue by developing a Job Analysis governing all tasks handed by an operator.

Other Safety Initiatives

- Locomotive Safety Standards

With the advance of technology including self-diagnostic equipment, railroads have asked FRA to consider revisions to the requirements of daily and quarterly inspections to reduce unnecessary activities. The industry also seeks a relaxation of the requirement for operative sanders on all locomotives because this is an efficiency issue (traction) rather than a safety issue (emergency braking)

- Roadway Worker – Revisions to Rules

Comprehensive rules to protect engineering employees from being struck by trains and maintenance equipment were established in 1996 in the first “negotiated rulemaking” using what later became the Rail Safety Advisory Committee process. Since that time some discrepancies in the rule have been identified and other components are being updated.

- Continuous Welded Rail Inspection

A rule is being developed to address the inspection of joint bars in CWR territory. The level of inspections will be contingent upon traffic volumes and train speeds.

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FINAL DRAFT

Current Status of Fatigue Management
in the Railroad Industry

Patrick Sherry, Ph.D.
Associate Professor
Director, National Center for Intermodal Transportation
Intermodal Transportation Institute
University of Denver

[6] Bailey Yard is the world’s largest classification yard covering 2,850 acres with a total length of 8 miles. The yard handles 10,000 cars daily, of which 3,000 are classified in the two hump yards. http://www.uprr.com/aboutup/history/bailey/index.shtml

Executive Summary

Since the Author's last review in 2000, the US railroad industry has continued to address fatigue through a combination of educational efforts, adjustments to work schedules, sleep disorder screening efforts, and the experimenting with technological aides to fatigue management. Although the emphasis has shifted from specific work schedules to a more flexible approach, in some cases the industry has achieved as high as 85% scheduled operations. Elsewhere the industry has utilized a modified scheduling such as the 7 on 3 off approach called the 7-3 overlay that provides employees with optional designated days off. In addition, the majority of the industry has moved towards a practice of a minimum of 10 hours undisturbed rest following an 8 hour period of duty.

The opportunity for major improvement still exists in the industry and joint efforts between labor and management to resolve these issues are needed. While some of the work schedules provide for designated time off, the possible effects of restricted sleep and accumulated sleep debt on performance will require additional attention. Because the industry is built around a continuous 24/7 operating system progress needs to be made to address the cumulative effects of fatigue that may result from the number of consecutive days worked. In addition, operational practices have yet to address the circadian nature of the fatigue on human performance. Current practices also do not take into account the so-called "limbo time" spent off-duty but on the train awaiting transport. While not an immediate safety issue, these time periods contribute to total time awake and subsequent hours asleep. Labor and management need to work on these problems together because the existing pay structure provides incentives to both labor and management to maintain the status quo and provides incentives for employees and management to push the limits of the envelope in of fatigue and human performance.

The National Transportation Safety Board (NTSB) has indicated that fatigue is a possible contributing factor in the 18 accidents investigated in a ten year period and has investigated over seventeen accidents that were thought to have fatigue as a possible contributing factor. However, given the fact that there are close to 10 million crew starts in a given year, with relatively few accidents identified as having fatigue as a causal factor, it is difficult to quantify the contribution of fatigue to railroad safety. The railroad industry has acknowledged the role of fatigue and has engaged in considerable effort to attempt to manage the effects of fatigue in the railroad operating environment. It should be apparent however that fatigue, while present, needs to be carefully managed from a *risk-based* perspective as opposed to a *prescriptive* mandate applied system-wide.

Fatigue has been addressed through the utilization of a number of different counter measures outlined in an industry statement dated on February 23, 1998 which noted that an effective Fatigue Countermeasures Program (FCP) should consider, but is not limited to, the following:

a. Education and Training
b. Employee and Train Scheduling Practices (e.g., line-ups, calling times, work/rest cycles, relief-staffing, employee availability, shift predictability)
c. Emergency response requirements short-term (e.g., derailments) and extended (e.g., natural disasters)
d. Alertness strategies (e.g., napping, employee empowerment)
e. Evaluation of policies and procedures (e.g., effects on fatigue issues)
f. Rest environments (e.g., lodging)
g. Work environments
h. Implementation strategies and review of FCP effectiveness.

Railroads have engaged in a major effort to develop and disseminate information on the factors that influence human fatigue, the countermeasures that can be used to address it, and the

impact of fatigue on performance. Significant efforts have been made to develop and disseminate educational materials to railroad employees in all of the major railroads. These range from short safety videos describing the dangers of sleep deprivation to more sophisticated training materials including at least a dozen videos on special topics related to fatigue management, a computer based education program that can be completed online, brochures, educational materials for employees and families, and even educational materials designed for elementary school students. The FRA co-sponsored a major effort to educate family members and children of railroad employees to the effects of fatigue and offer suggestions as to how family members could support and encourage fatigue management. Most importantly the railroads have incorporated fatigue education in their required periodic training for employees. These efforts have resulted in the "institutionalization" of the dissemination of fatigue management information as part of the railroad's "way of doing business." In essence, fatigue management has begun, as one railroad management executive put it "to become standard operating procedure."

The railroads have experimented with a number of different work schedule options. Different approaches were tried in different locations in keeping with the lesson that "one size doesn't fit all" in the railroad industry. Various compressed schedules (7 on- 3 off, 8 on – 3 off, 10 on – 5 off, etc.) were tried. Some are still in effect today. However, with the impact of 9/11 and the turbulence in the economy there has been some consolidation in approaches with railroads focusing on achieving a scheduled railroad, a 7-on/3-off overlay (BNSF), use of meet and return (CN), and the implementation in many locations of a mandatory 10 hours undisturbed rest rule have become the norm. Additional progress towards improved predictability of start times is needed.

The railroad industry has improved its sleep disorder screening and updated its procedures for ensuring that railroad employees are fit for duty. A safety advisory was issued by the FRA, following the determination by the NTSB that the probable cause of the November 15, 2001, Canadian National/Illinois Central Railway CN/IC accident in Clarkston, Michigan, was crewmembers' fatigue primarily due to the engineer's untreated and the conductor's insufficiently treated obstructive sleep apnea. The Safety Board examined the adequacy of rail industry standards and procedures for identifying and reporting potentially incapacitating medical conditions. The NTSB recommended (NTSB, 2002) that the railroad industry update its medical screening procedures to include sleep disorders. The resulting combined efforts of the railroad industry, labor, and the FRA have resulted in a new safety advisory that addresses the need to screen for the effects of health and physical conditions that might impact safety on the railroad -- specifically the need to screen for sleep disorders. Work is in progress on developing a set of medical standards that will include sleep disorders and other factors that might affect alertness.

In April of 2003 the Canadian Minister of Transport put into effect new rules for fatigue management in the rail industry affecting both Canadian and US railroads with Canadian operations. The new rules set a maximum of 12 hours for a single shift. The rules also allow an employee to work more than one shift per day, up to a maximum of 18 hours in total. In addition to daily limits, the new rules also included a weekly cap of 64 hours. Previously, no explicit weekly cap existed. Most importantly, the new rules also required that fatigue management plans be filed with Transport Canada describing industry plans for addressing fatigue on the railroad. This rule required most US railroads with operations in Canada to draft fatigue management plans and submit them to the Canadian government.

Two new efforts to improve technology associated with fatigue management have included efforts to validate a mathematical model that enables the prediction of the likely level of fatigue at a given point in time based on previous work/rest history. Railroads have provided work/rest histories and accident data to the FRA to support the validation process. In addition, several studies have looked at the use of actigraphs in the operating environment as a means of providing accurate measurements of the effects of work/rest practices in the operating environments. An actigraph is a wristwatch-like device that records wrist movement. Decreased

movement indicates the person is probably asleep and data from the device can be used to track sleep / wake cycles. Also, the use of performance feedback actigraphs has been examined as well. These show considerable promise to be useful tools for the industry in order to evaluate levels of work at different points on a railroad and to objectively measure any changes resulting from a countermeasure. While FRA has also said the model could be useful for determining whether fatigue might have contributed to an accident there is general agreement that models are far from able to serve as a fitness for duty screening device for an individual employee.

The present edition of *Fatigue Countermeasures in the Railroad Industry: Current Practices* reviews previous data, practices, projects and programs that have continuing significance and describes the current educational interventions, recent technological developments, scheduling approaches, and both previous and current scientific developments on human fatigue as it applies to the railroad industry. It also discusses a variety of interventions that have been tried in an attempt to address fatigue in the railroad industry. The study concludes with a review of the current status of fatigue countermeasures and identifies a number of key features found in successful programs.