



National Transportation Safety Board

Washington, D.C. 20594

Highway Accident Brief

Accident No.: HWY-04-MH-031
Accident Type: Rear-end collision—two tractor-semitrailers and passenger vehicle
Location: Eastbound Interstate 94 at Fletcher Road overpass, near Chelsea, Michigan
Date and Time: July 16, 2004, approximately 12:00 p.m.
Vehicle 1: 2000 Kenworth tractor and 2000 Hyundai semitrailer
Owner 1: Equity Transportation Company, Inc. (USDOT No. 190081)
Injuries 1: 1 fatal
Vehicle 2: 1999 Sterling tractor and 1997 Great Dane semitrailer
Owner 2: Ryder Integrated Logistics, Inc.
Injuries 2: 1 minor
Vehicle 3: 2004 Saturn station wagon
Owner 3: Private vehicle
Injuries 3: 1 minor

Accident Description

On Friday, July 16, 2004, about 12:00 p.m., a 1999 Sterling tractor towing a 1997 Great Dane semitrailer was part of a traffic queue moving slowly¹ east on Interstate 94 (I-94), behind a 2004 Saturn station wagon approaching the Fletcher Road overpass. (See figure 1.) The queue had formed following an earlier accident in the eastbound lanes of a highway maintenance zone. At the same time, a 2000 Kenworth tractor towing a 2000 Hyundai semitrailer, owned by Equity Transportation Company, Inc. (Equity), was traveling behind the queue on I-94, approaching the Fletcher Road overpass at a witness-estimated speed of 60 mph. The Kenworth driver failed to slow in time for the traffic queue ahead. A 115-foot preimpact skid mark indicated that the Kenworth driver applied the brakes and swerved to the right almost immediately before his truck collided with the Sterling's semitrailer. The left front of his truck struck the right rear of the Sterling's semitrailer, compressing the cab of the Kenworth about 6 feet to the rear, trapping and fatally injuring its driver. (See figure 2.) The impact propelled the Sterling tractor-semitrailer into the Saturn in front of it, resulting in minor injuries to the Sterling driver and to a passenger in the Saturn.

¹ According to the driver of the Sterling tractor, traffic slowed from 70 mph to 30 mph about a mile before the accident location.

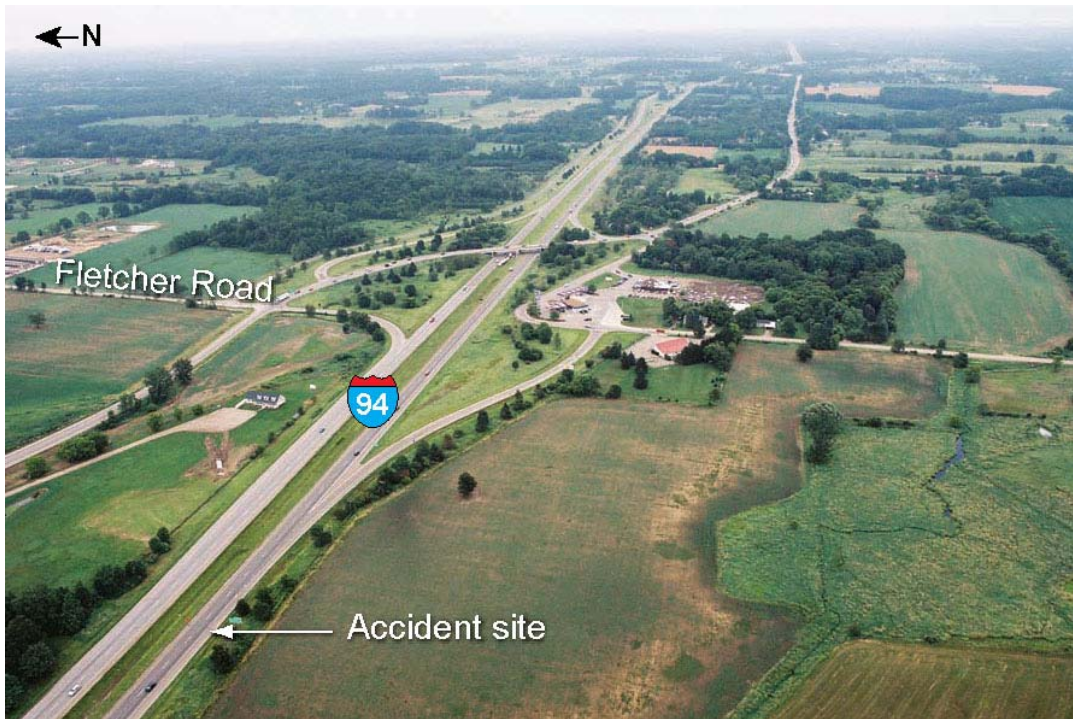


Figure 1. East-facing aerial view of accident site.



Figure 2. This postaccident lateral view of the Kenworth tractor shows the extent to which the cab was crushed rearward. The front of the tractor is on the left.

The weather was clear and the roadway was dry. The Kenworth driver's sight distance was more than 1 mile. The accident occurred within a 25-mile-long maintenance zone that involved 21 bridge renovation projects.

Accident Vehicle

The 2000 Kenworth, model T-900, was a three-axle conventional truck-tractor equipped with a sleeper berth. The tractor had a wheelbase of 260 inches and was 28.5 feet long. The overall length of the combination unit was approximately 73 feet. The impact damage to the Kenworth tractor was concentrated along the front-left corner of the radiator to the left end of the front bumper, a distance of approximately 31 inches. The impact resulted in the cab's being crushed approximately 6 feet rearward above the frame along the left side of the vehicle. The front half of the cab was also displaced from the frame and rotated counterclockwise almost 80°. Investigators measured the postcrash interior depth of the cab, including the driver's seating area and sleeper berth, to be 36 inches. According to the manufacturer, the interior depth of an undamaged cab is 113 inches. (See figure 3.)



Figure 3. Interior cab of the Kenworth tractor after the accident.

Accident Driver

The 62-year-old driver of the Kenworth/Hyundai tractor-semitrailer combination held a Michigan Class “A” commercial driver’s license (CDL) with no endorsements or restrictions, which was valid through April 10, 2008. A postmortem toxicological examination of the driver’s blood was negative for drugs and alcohol. The driver was wearing his seat belt at the time of the accident.

The driver had about 2 years’ experience driving tractor-semitrailers. In July 2002, he began a 3-month CDL training program with Equity and, upon completion of the program, drove full-time with the company until the accident. Before operating commercial vehicles, he had worked full-time in the manufacturing and service sectors and part-time as a small engine mechanic. The driver had undergone cardiac bypass surgery in February 2000 following several episodes of unstable angina.² He was unable to continue his former employment due to his health and was unemployed for more than 2 years before joining Equity.

At the time of the accident, the driver had a medical certificate that was current through October 10, 2004. Records from the driver’s personal physician indicate that the driver was not taking any prescription medications. The driver had undergone a commercial driver fitness examination in July 2003, during which the certifying examiner requested additional records regarding the driver’s bypass surgery and postsurgical evaluation. The certifying examiner then limited the driver’s certification to 1 year instead of the standard 2 years. Upon reevaluation in July 2004, the driver was given 3 months to take a stress test and obtain an electrocardiogram. The driver was involved in the accident less than a week after the reevaluation. According to the driver’s wife, he had expected to retire before the expiration date of his current medical certificate and had not yet undergone the tests. Investigators considered whether the driver could have had newly symptomatic coronary artery disease that resulted in impairment or incapacitation, but there was no indication of such an event, and the driver made steering and braking inputs immediately prior to the collision.

Safety Board investigators interviewed Equity personnel and examined the driver’s record-of-duty-status (RODS) logs to determine his activities prior to the accident.³ According to Equity, the accident driver began what was to be his final trip on July 15, 2004, at the terminal in Grand Rapids, Michigan. The load being hauled consisted of cardboard, and the driver was paid by the mile for the trip. He was to make stops at Ada, Michigan; Bensenville, Illinois; Valparaiso, Indiana; and Ypsilanti, Michigan. Shipping documents available to investigators did not include scheduled delivery times. The trip mile total for this route is approximately 509 miles, assuming one stop per destination. The driver was approximately 22 miles from his final destination when the accident occurred.

² *Unstable angina* is chest pain or discomfort caused by inadequate blood flow through the blood vessels of the heart muscle.

³ The driver’s last previous job for Equity had been on July 13, and his logs indicated that he had slept in his sleeper berth on the night of July 14. Because the driver died in the accident, Safety Board investigators could not construct a 72-hour history for this driver, beyond the information provided in his log, which, as detailed in this report, did not correspond with electronic documentation.

Several days' pages from the driver's logs were found in the accident vehicle: these covered June 30, July 1 and 2, July 6 through 9, and July 12. In addition, investigators found a crumpled and torn log sheet for July 16, which indicated that the driver had been on duty from midnight until 1:45 a.m., had conducted a pretrip inspection at 5:00 a.m., and had begun driving at 5:15 a.m.

The driver's missing logs for July 13 through 15 and a second, more complete, log for July 16 were obtained from family members.⁴ These logs indicated that the driver was off duty for 18.5 hours before beginning his last trip at 4:15 p.m. on July 15. According to the logs, he was on duty until 1:45 a.m., at which time he rested for 6.25 hours. The logs then indicated that the driver went back on duty at 8:00 a.m., was on duty and driving from 8:15 a.m. until 10:45 a.m., and changed status to "on duty, not driving," until 11:00 a.m.

Investigators compared the driver's written logs to global positioning system (GPS) data obtained from Equity, which uses an electronic dispatch system based on GPS technology. The GPS installed in Equity trucks automatically tracks the time, location, and ignition status of the trucks every hour. Because the GPS data provided an objective, valid, and reliable source of time and location information, Safety Board investigators were confident in comparing these data to the accident driver's written logs and in using GPS data to reconstruct the driver's schedule. (See figure 4.) The GPS data stored by Equity for the accident driver spanned the period from 3:13 p.m. on July 14 until the accident occurred. The data indicated that the driver did not operate the truck from 9:30 p.m. on July 14 until 4:15 p.m. on July 15, which coincides with his paper logs. He was then on duty continuously for 19.75 hours, from 4:15 p.m. on July 15 until the accident about 12:00 p.m. on July 16, exceeding by 5.75 hours the maximum continuous duty hours allowed by Federal regulations. The driver also had driven almost 14 cumulative hours during the 19.75-hour on-duty period, nearly 3 hours beyond the time permitted by Federal regulations.

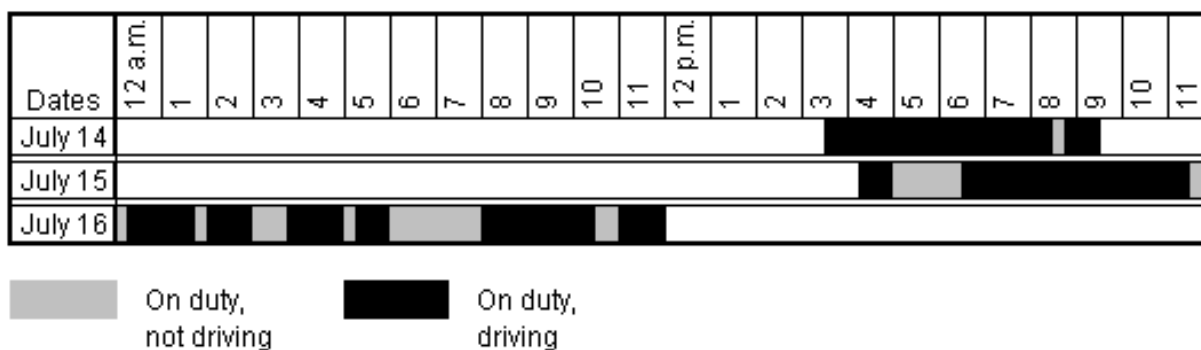


Figure 4. Accident driver's hours of service prior to Chelsea accident, reconstructed from GPS electronic data.

⁴ After the accident, most of the driver's effects were given to his family.

Research has shown that a combination of reduced sleep and fatigue from long-distance driving can significantly increase reaction time.⁵ While individuals experiencing sleep loss can usually rally momentarily to perform at their non-sleep-deprived levels, their ability to maintain that performance decreases as the length of the task increases.⁶ Furthermore, the longer a person is continually awake beyond 14 to 16 hours, the greater the occurrence and duration of attention lapses.⁷ Driver sleepiness and fatigue have been strongly linked with commercial vehicle crashes by the Safety Board and others.⁸

Title 49 *Code of Federal Regulations* (CFR) 395.3 states that a motor carrier cannot permit a driver to exceed 11 cumulative hours of driving following 10 consecutive hours off duty, to exceed 14 hours on duty following 10 consecutive hours off duty, or to drive after being on duty for 60 hours in 7 consecutive days or for 70 hours in 8 consecutive days.⁹ The Federal Motor Carrier Safety Administration (FMCSA) has issued interpretations and guidance to emphasize and clarify hours-of-service responsibilities for motor carriers.¹⁰ These interpretations and guidance indicate that the FMCSA “holds the motor carrier liable for violations of the hours of service if it had or should have had the means to detect the violations.” The guidance also states, “Intent or actual knowledge by the motor carrier is not a necessary element of liability, and carriers ‘permit’ violations if they do not have a management system that prevents such violations.”

Motor Carrier

Driver Oversight

Equity Transportation Company, Inc., is registered with the FMCSA as an interstate “for hire” carrier of general freight, refrigerated food, and beverages. Equity began operation in 1980 and currently operates throughout the continental United States and Canada. At the time of the accident, Equity operated 157 tractors and 541 semitrailers and employed 154 drivers.

⁵ Pierre Philip and others, “Fatigue, Sleep Restriction, and Performance in Automobile Drivers: A Controlled Study in a Natural Environment,” *Sleep*, Vol. 26, No. 3 (2003): 277–280.

⁶ Michael Bonnet, “Sleep Deprivation,” eds. M.H. Kryger, T. Roth, and W.C. Dement, *Principles and Practice of Sleep Medicine*, Third Edition (Philadelphia, PA: W.B. Saunders Company, 2000).

⁷ National Transportation Safety Board, *Fatigue Symposium Proceedings, November 1–2, 1995*, RP-95-02 (Washington, DC: NTSB and National Aeronautics and Space Administration Ames Research Center, 1995) 42.

⁸ (a) European Transport Safety Council, *The Role of Driver Fatigue in Commercial Road Transport Crashes* (Brussels: ETSC, 2001). (b) *Evaluation of U.S. Department of Transportation Efforts in the 1990s to Address Operator Fatigue*, Safety Report NTSB/SR-99/01 (Washington, DC: NTSB, 1999). (c) National Transportation Safety Board, *Analysis*, Vol. 1 of *Factors That Affect Fatigue in Heavy Truck Accidents*, Safety Study NTSB/SS-95/01 (Washington, DC: NTSB, 1995). (d) U.S. Department of Transportation, J.S. Wang and R.R. Knipling, *Single Vehicle Roadway Departure Crashes: Problem Size Assessment and Statistical Description*, Report No. DOT-HS-808113 (Washington, DC: USDOT, 1994). (e) National Transportation Safety Board, *Fatigue, Alcohol, Other Drugs, and Medical Factors in Fatal-to-the-Driver Heavy Truck Crashes*, Safety Study NTSB/SS-90/01 (Washington, DC: NTSB, 1990).

⁹ According to 49 CFR 395.13, a driver may restart a 7- or 8-consecutive-day on-duty period by taking 34 or more consecutive hours off duty.

¹⁰ Information accessed May 11, 2006, from <www.fmcsa.dot.gov/rulesregs/fmcsr/regs/interp395.3.htm>.

Equity drivers use handwritten logs to record their hours of service. These handwritten logs are recorded on loose-leaf log paper instead of staple-bound report books. Equity's safety director stated that the company uses loose-leaf logs at the request of its drivers. According to Equity's safety director, the company has a log review program in place, under which it electronically scans the written logs of all its drivers and checks them for hours-of-service violations. Additionally, 50 percent of the logs are verified by comparing them with supporting documentation, such as fuel receipts, toll receipts, and driver trip information. The logs of drivers who were placed out of service during a roadside inspection or who were involved in an accident are included in the verification process. Drivers who violate hours-of-service regulations may be disciplined by having their tractor's top speed reduced,¹¹ by not being reimbursed for expenses, by being suspended, or by being dismissed.

According to data obtained from the Motor Carrier Safety Status Measurement System (SafeStat),¹² Equity drivers underwent 500 roadside inspections from July 18, 2002, through July 18, 2004, which resulted in 76 drivers being placed out of service. The resulting 15.2-percent out-of-service rate may be compared to the national driver out-of-service rate of 7.2 percent. Of the 76 drivers who were placed out of service, 73 had violated at least one Federal hours-of-service regulation.

Equity does not use data from its electronic data systems to verify drivers' written logs. According to the Equity safety director, the data gathered from GPS are typically stored only for about 2 or 3 days because of limited electronic storage.

FMCSA policy does not require motor carriers to maintain electronic data as part of their supporting documentation because the FMCSA believes "Intelligent Transportation (IT) systems have not yet advanced to the point where electronic monitoring of supporting documents by enforcement officers is a feasible substitute for RODS."¹³ The FMCSA also notes that motor carriers are still reluctant to integrate their data systems with those of the enforcement community in a way that would allow real-time access to supporting documents. Nevertheless, the FMCSA prefers electronically based record-keeping methods to traditional paper records and does allow electronic data (for example, GPS data, automatic vehicle identifier transponders, and electronic bills of lading) to be kept in conjunction with paper supporting documents, as long as the data are maintained for more than 6 months and are accessible and reviewable by FMCSA agents.

¹¹ An Equity vehicle's normal electronically regulated speed of 67 mph would be reduced to 64 mph.

¹² SafeStat is an automated, data-driven analysis system that combines current and historical carrier-based safety performance information to measure the relative (peer-to-peer) safety fitness of interstate commercial motor carriers and intrastate commercial motor carriers that transport hazardous materials. This information includes Federal and State data on crashes, roadside inspections, on-site compliance reviews, and enforcement history.

¹³ Federal Motor Carrier Safety Administration, Supplemental Notice of Proposed Rulemaking "Hours of Service of Drivers; Supporting Documents," 69(212) *Federal Register* 63998, November 3, 2004 (Washington, DC: National Archives and Records Administration, 2004).

Compliance Reviews

Equity. In its most recent FMCSA compliance review before the Chelsea accident (November 2003), Equity was rated satisfactory.¹⁴ This compliance review was initiated as a follow-up to a February 2003 enforcement action for violations of the hours-of-service regulations, and also because Equity was identified as a category “B” carrier in SafeStat.¹⁵ The FMCSA had already planned to perform a compliance review on Equity prior to the accident, in response to complaints from two former drivers who alleged that Equity had scheduled trips that forced them to exceed Federal hours-of-service limits.¹⁶ This compliance review, the results of which were issued on July 27, 2004, and which resulted in a conditional rating for the carrier, revealed a 20-percent falsification rate of driver’s logs.¹⁷ Other log violations included driving for more than 11 hours following 10 consecutive hours off duty, staying on duty for more than 14 hours following 10 consecutive hours off duty, and driving after being on duty for more than 70 hours in an 8-day period.

In September 2004, following the July 2004 FMCSA compliance review, Safety Board investigators examined the paper logs and supporting documents of 11 Equity drivers who drove frequently from July 27 through August 3, 2004.¹⁸ Paper records and electronic data for six Equity drivers were also examined for the period from August 30 through September 7, 2004. The paper logs of one driver were illegible and could not be reviewed.¹⁹ Violations were found in the logs of all the remaining drivers, including 51 false entries, 1 violation of the 70-hour driving rule, 5 violations of the 14-hour driving rule, and 6 violations of the 11-hour driving rule.

¹⁴ Safety ratings are defined by 49 CFR 385.5 as follows: (1) *Satisfactory*—motor carrier has in place and functioning adequate safety management controls to meet the safety fitness standard prescribed in Section 385.5. Safety management controls are adequate if they are appropriate for the motor carrier’s size and type of operation. (2) *Conditional*—motor carrier does not have adequate safety management controls in place to ensure compliance with the safety fitness standard, which could result in the occurrences listed in Section 385.5 (a) through (k). (3) *Unsatisfactory*—motor carrier does not have adequate safety management controls in place to ensure compliance with the safety fitness standard, which has resulted in occurrences listed in Section 385.5 (a) through (k). (4) *Unrated*—motor carrier has not been assigned a safety rating by the FMCSA.

¹⁵ Carriers are rated from “A” to “H,” based on their SafeStat scores, with “A” being the poorest safety fitness assessment rating (the higher the calculated score, the poorer the assessed rating). Equity’s SafeStat score on June 25, 2004, was 304.41. This relatively high score earned the company a “B” rating.

¹⁶ The accident driver’s son, who had been a driver for Equity and resigned his position after the accident, alleged that Equity dispatchers routinely pressured drivers to exceed the on-duty limits stipulated by Federal regulations. He cited as an example the same trip from Walker, Michigan, to East Greenville, Pennsylvania, that the other two former drivers had mentioned. The allegations concerning scheduling could not be verified during the compliance review due to a lack of supporting documents. As a result of the review, however, Equity was fined for unrelated hours-of-service violations.

¹⁷ A 10-percent falsification rate counts as a critical violation in the “driver” category of a compliance review. Because this is an hours-of-service violation, the FMCSA rated Equity unsatisfactory in this category.

¹⁸ Investigators were able to identify these drivers because Equity pairs each driver with a tractor and advertises the availability of its tractors and semitrailers on the Internet at <<http://www.equityinc.com>>. Electronic records were unavailable for these drivers at the time of the request due to Equity’s limited retention period for such records.

¹⁹ Illegible logs are in violation of 49 CFR 395.8(f)(2), which requires that entries be legible and in the driver’s own handwriting.

Since July 2004, Equity has received satisfactory ratings in two additional compliance reviews, the most recent of which occurred on March 22, 2007.

Previous Safety Board Action. For some years, the Safety Board has been concerned about the adequacy of compliance reviews of motor carriers and has expressed its concerns in several accident reports.²⁰ In 1995, the Safety Board investigated a fatal motorcoach accident that involved a carrier with a 9-year history of repeated hours-of-service and vehicle-related violations.²¹ Despite the carrier's record, the Office of Motor Carriers²² continued to rate the carrier satisfactory in its compliance reviews. As a result, the Safety Board issued Safety Recommendation H-99-6 to the U.S. Department of Transportation, recommending that the department,

H-99-6

Change the safety fitness rating methodology so that adverse vehicle and driver performance-based data alone are sufficient to result in an overall unsatisfactory rating for the carrier.

The Safety Board has twice reiterated Safety Recommendation H-99-6, most recently in response to the Wilmer, Texas, bus fire accident,²³ and the recommendation is currently classified "Open—Acceptable Response." This recommendation is on the Safety Board's List of Most Wanted Transportation Safety Improvements.²⁴

In a 2006 response to Safety Recommendation H-99-6, the FMCSA stated that, as part of its Comprehensive Safety Analysis (CSA) 2010 Initiative, it is reviewing the compliance review process and developing a new safety fitness rating methodology based on an objective measure of driver or carrier safety performance data. The FMCSA expects to deploy the new methodology by 2010. In its reply to the FMCSA, the Safety Board noted that even if the FMCSA achieves its milestone, the expected time frame for implementation of the new program is several years away. In the interim, deficiencies in the current compliance review system allow unsafe carriers to operate and should be remedied to protect the traveling public. Therefore, on June 22, 2007, the Safety Board issued a safety recommendation that asked that the FMCSA,

²⁰ (a) National Transportation Safety Board, *Collision Between Truck Tractor Semitrailer and School Bus near Mountainburg, Arkansas, May 31, 2001*, Highway Accident Report NTSB/HAR-02/03 (Washington, DC: NTSB, 2002). (b) National Transportation Safety Board, *Motorcoach Run-off-the-Road and Rollover off Interstate 90, Victor, New York, June 23, 2002*, Highway Accident Report NTSB/HAR-04/03 (Washington, DC: NTSB, 2003). (c) National Transportation Safety Board, *Motorcoach Fire on Interstate 45 During Hurricane Rita Evacuation Near Wilmer, Texas, September 23, 2005*, Highway Accident Report NTSB/HAR-07/01 (Washington, DC: NTSB, 2007).

²¹ National Transportation Safety Board, *Selective Motorcoach Issues*, Special Investigation Report NTSB/SIR-99/01 (Washington, DC: NTSB, 1999).

²² The Office of Motor Carriers is now the FMCSA.

²³ NTSB/HAR-07/01.

²⁴ The Safety Board's "Most Wanted" program was established to increase the public's awareness of and support for action to adopt safety steps that can help prevent accidents and save lives.

H-07-3

To protect the traveling public until completion of the Comprehensive Safety Analysis 2010 Initiative, immediately issue an Interim Rule to include all *Federal Motor Carrier Safety Regulations* in the current compliance review process so that all violations of regulations are reflected in the calculation of a carrier's final rating.

Safety Recommendation H-07-3 is classified "Open—Await Response."

Electronic On-Board Recorders

In January 2007, the FMCSA published a notice of proposed rulemaking (NPRM) that would require motor carriers with a "demonstrated history of serious noncompliance with hours-of-service (HOS) rules" to be subject to mandatory installation of electronic on-board recorders (EOBRs) meeting proposed standards of accuracy, validity, and security.²⁵ (Equity's GPS-based electronic dispatch system is similar to the EOBRs that have been proposed to track driver hours of service.) According to the NPRM, a carrier is recognized as a pattern violator of hours-of-service regulations if it is found to have a violation rate of 10 percent or more of any regulation currently listed in Part 385, Appendix B, Section VII, of the *Federal Motor Carrier Safety Regulations* during any two compliance reviews performed over a 2-year period. Carriers identified as pattern violators would be required to use EOBRs, instead of paper logs, to track and record driver hours of service for 2 years.

Equity was cited for exceeding a violation rate of 10 percent for a particular hours-of-service regulation in the July 2004 compliance review. However, Equity would not be identified as a pattern violator under the FMCSA's proposed rules because, although compliance reviews conducted in 2005 and 2007 identified numerous hours-of-service violations, the carrier did not exceed a violation rate of 10 percent on any particular hours-of-service regulation.

According to the NPRM, pattern violators will be identified exclusively via compliance reviews. In 2005, the FMCSA performed a total of 8,097 compliance reviews on the approximately 911,000 active and registered motor carriers; this means that less than 1 percent of all carriers were assessed for safety and fitness. Moreover, flaws in the compliance review procedures guarantee that even if the NPRM provisions are implemented, many unsafe carriers will continue to evade even initial identification as an hours-of-service violator.

In its NPRM response, the Safety Board stated that, in light of deficiencies in the current compliance review program, it does not believe that the FMCSA has the resources or processes necessary to identify and discipline all carriers and drivers who are pattern violators of hours-of-service regulations. Consequently, a program to impose EOBRs on pattern violators that relies on the current compliance review program to identify such carriers is unlikely to be successful.

²⁵ Federal Motor Carrier Safety Administration, NPRM "Electronic On-Board Recorders for Hours-of-Service Compliance," 72(11) *Federal Register* 2340, January 18, 2007 (Washington, DC: National Archives and Records Administration, 2007).

The FMCSA outlined a series of financial and regulatory incentives in the NPRM to persuade carriers to install EOBRs voluntarily in their motor vehicles. The Safety Board stated in its NPRM response that it is unconvinced that these incentives are sufficient to override the financial motivation that pattern violators have for continuing to circumvent hours-of-service regulations and to not use EOBRs for tracking hours of service. The Safety Board further stated that the proposed use of EOBRs as a form of remediation or punishment may taint industry perceptions of the technology and undermine the FMCSA's goal of achieving voluntary, industrywide acceptance. The Safety Board's position, as stated in its NPRM response, is that the only way that EOBRs can effectively help stem hours-of-service violations, and thereby reduce accidents involving a commercial driver's reduced alertness or fatigue, is for the FMCSA to mandate EOBR installation and use by all operators subject to hours-of-service regulations.

Highway

The Chelsea accident occurred within the 25-mile-long temporary traffic control (TTC) zone²⁶ that comprised the Michigan Department of Transportation's (MDOT's) I-94 Federal Aid Bridge Rehabilitation Project. The project, which included 21 bridges along the I-94 corridor from Ann Arbor west to Jackson County (see figure 5), began in April 2004 at separate work sites on the east and west ends of the TTC zone and ended in May 2006. The posted speed limit within the TTC zone was 60 mph for all vehicles.



Figure 5. Extent of the I-94 Federal Aid Bridge Rehabilitation Project.

Merge Traffic Capacity Analysis

Since the beginning of the rehabilitation project, witnesses reported experiencing traffic queues as a result of work-related lane closures. One method available to MDOT engineers to address such anticipated queues would have been to conduct a merge traffic capacity analysis, which is used to predict the effects of lane closure on traffic density, traffic flow, and other

²⁶ The 1994 (revised in 2001) *Michigan Manual on Uniform Traffic Control Devices* (Michigan MUTCD) defines a TTC zone as “the entire section of a roadway between the first advance warning sign through the last traffic control device where traffic returns to its normal path and conditions.”

highway variables. The *Highway Capacity Manual 2000*²⁷ and published research on queuing resulting from TTC zone lane closures²⁸ provide a process for calculating queue lengths and delays. MDOT stated that it generally performs a merge traffic capacity analysis before starting a highway construction project to predict the effects of lane closures on traffic queuing but did not do so for the bridge rehabilitation project because it considered this effort to be highway maintenance, rather than construction. When, postaccident, the Safety Board applied the analysis process to the hourly traffic volumes from MDOT's traffic count database, the analysis showed that merging from two lanes to one would produce traffic queue lengths of well over 1 mile for several hours each weekday.

Conducting a merge traffic capacity analysis would have enabled MDOT to identify high-density traffic zones. This information would have allowed engineers to create a traffic control plan to better accommodate the longer traffic queues in the eastern section of the project, thereby providing motorists with proper warning and reducing the possibility of rear-end accidents by unprepared drivers. MDOT could also have used data from the merge traffic capacity analysis to properly evaluate the acceptability of traffic queues in the western section of the project and to consider other alleviation options, such as expanding and utilizing the left shoulder as a through lane or restricting maintenance to nighttime and weekend hours.

On April 30, 2007, MDOT informed the Safety Board that it would begin conducting merge traffic capacity analyses for all work zone projects by October 12, 2007, as part of an effort to comply with updated regulatory language in 23 CFR Part 630, Subpart J.²⁹ These regulations require each State to implement a work zone policy that systematically considers and manages the safety and mobility impacts of all Federal-aid highway projects. States are required to create processes and procedures to implement and sustain these policies and are further required to collect and analyze data to continually improve upon these processes and procedures.

Traffic Control Devices

According to MDOT, as the I-94 rehabilitation project progressed, TTC devices at individual work sites were to have been removed or covered. During its postaccident investigation, the Safety Board discovered several TTC devices in place at apparently completed or inactive work sites. For example, investigators found inactive work sites with "Road Work Ahead" signs in place and no "End Road Work" signs to indicate the end of the TTC zone. MDOT regional traffic engineering and construction supervisors, as well as personnel from MDOT headquarters, subsequently acknowledged this lack of continuity in TTC placement.

²⁷ Transportation Research Board, *Highway Capacity Manual 2000*. See <www4.trb.org/trb/homepage.nsf/web/hcm>.

²⁸ (a) Yi Jiang, "Estimation of Traffic Delays and Vehicle Queues at Freeway Work Zones," Paper No. 01-2688, Transportation Research Board, 80th Annual Meeting, January 7 through 11, 2001, Washington, D.C. (b) Taehyung Kim, David Lovell, and Jawad Paracha, "A New Methodology to Estimate Capacity for Freeway Work Zones by 2000," Paper No. 01-0566, Transportation Research Board, 80th Annual Meeting, January 7 through 11, 2001, Washington, D.C. This study summarized field-measured capacities for lane closures documented in previous studies.

²⁹ Federal Highway Administration, Final Rule "Work Zone Safety and Mobility," 69(174) *Federal Register* 54562, September 9, 2004 (Washington, DC: National Archives and Records Administration, 2004).

In 2005, MDOT instituted a pilot policy for a limited number of work zone projects that it stated significantly reduced the number of deficient, inadequate, or improperly placed TTC devices. Under the policy, if an MDOT engineer documents a TTC device that is deficient, inadequate, or improperly placed, the engineer immediately notifies the highway contractor that it has 4 hours to correct the problem. If it is not corrected within 4 hours, the contractor is to be fined \$100 per hour until the problem is corrected.³⁰ In 2007, MDOT implemented this policy for work zone projects statewide.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the July 16, 2004, multiple-vehicle accident near Chelsea, Michigan, was the accident driver's failure to stop upon encountering traffic congestion in a temporary traffic control zone likely due to a reduced state of alertness associated with failure to obtain adequate rest. Contributing to the accident were Equity Transportation Company, Inc.'s, insufficient regard for, and oversight of, driver compliance with Federal commercial motor vehicle hours-of-service regulations, which endangered the safety of its drivers and the traveling public; the Federal Motor Carrier Safety Administration's failure to require motor carriers to use tamperproof driver's logs; and the Michigan Department of Transportation's failure to conduct a merge traffic capacity analysis as part of a bridge rehabilitation project.

Recommendations

As a result of this accident investigation, the National Transportation Safety Board made the safety recommendations listed below. For more information about these recommendations, see the Board's safety recommendation letters³¹ to the recipients.

To the Federal Motor Carrier Safety Administration:

Require all interstate commercial vehicle carriers to use electronic on-board recorders that collect and maintain data concerning driver hours of service in a valid, accurate, and secure manner under all circumstances, including accident conditions, to enable the carriers and their regulators to monitor and assess hours-of-service compliance. (H-07-41)

As an interim measure and until industrywide use of electronic on-board recorders is mandated, as recommended in Safety Recommendation H-07-41, prevent log tampering and submission of false paper logs by requiring motor carriers to create and maintain

³⁰ Michigan Department of Transportation, *Special Provision for Traffic Control Quality and Compliance Pilot Program*, September 21, 2004.

³¹ These letters are available on the National Transportation Safety Board's website, at <http://www.nts.gov/>.

audit control systems that include, at a minimum, the retention of all original and corrected paper logs and the use of bound and sequentially numbered logs. (H-07-42)

To Equity Transportation Company, Inc.:

Implement a driver log review program that accounts for, tracks, and audits all modifications to paper logs and that also collects and retains all available electronic supporting documentation to verify driver compliance with Federal commercial driver hours-of-service regulations. (H-07-43)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

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Adopted: December 4, 2007