



Log R-574A

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: May 11, 1987

In reply refer to: R-87-05
through -13

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About 8:12 a.m., eastern daylight time, July 10, 1985, eastbound two-car train No. 6601 struck the rear of three-car train No. 6614, which was standing inoperative on the eastbound main track of the Greater Cleveland Regional Transit Authority (GCRTA) Red Rapid Transit Line. Train No. 6614 was stuck in a reverse curve about 900 feet west of the West 98th Street Station in Cleveland, Ohio. The operators and conductors of both trains and a total of 46 of the approximately 400 passengers on the trains were transported to nearby hospitals. Two days after the accident, another passenger was admitted to the hospital for a cervical spine injury; the train crewmembers and the other passengers received outpatient treatment for minor injuries. The rear car of train No. 6614 was derailed and sustained rear end structural damage as a result of the collision impact.

From 1975, until this accident, the Safety Board had conducted in-depth major investigations of GCRTA (two accidents, one in 1976 and one in 1977) and field investigations of four accidents (in 1977, 1982, 1984, and 1985). ^{1/} The investigation of these accidents revealed a number of deficiencies in the manner in which the GCRTA operated its rail rapid transit system. These deficiencies included the failure to maintain its system adequately and the failure to provide adequate backup when it permitted trains to be operated into occupied blocks, in essence defeating the protective features of its automatic train stop signal system.

^{1/} These accidents occurred on the GCRTA on December 6, 1977, May 5, 1982, September 10, 1984, and November 4, 1985.

The Safety Board conducted a major investigation of this accident because of the number of accidents the GCRTA had experienced in its 10-year history of operating its rail rapid transit system and because of the issues uncovered during the Safety Board's investigation of six of the accidents.

The Safety Board's investigation determined that the Red Line had many signal shortcomings, which had been reported repeatedly to tower control supervisors, and to GCRTA's safety supervisor, and thus to GCRTA management. Further, the rail safety committee reported such problems to GCRTA twice in the 9 months preceding the accident. GCRTA did not have a stock of spare trip arms at the time of the accident, and had placed an order for only 10 trip arm replacements. Moreover, GCRTA apparently did not attempt to take undamaged trip arms from intermediate signals at non-critical locations to replace the broken trip arms at critical interlocking signals. Nevertheless, GCRTA managed to repair and restore the automatic train stop (ATS) function in 92 defective signals in scarcely more than 3 months after the accident.

In the report of its investigation of the head-on collision at Shaker Heights in 1977 2/, the Safety Board cited the inadequate maintenance of the Shaker Heights line by the GCRTA. The Safety Board found that more than 150 rail bond wires were broken in the Shaker Heights signal system. Several block signals were either malfunctioning or not functioning at all. On September 6, 1977, during the investigation of the Shaker Heights accident, the Safety Board issued Safety Recommendation R-77-26, requesting that GCRTA:

Immediately inspect and repair the block signal system and implement procedures for its maintenance to insure that it continues to function as intended.

On January 4, 1979, the GCRTA responded, telling the Safety Board that "the signal system had been repaired and was functional as of December 1977 and that signal personnel ride all routes on a daily basis, inspecting and maintaining the system". The Safety Board closed R-77-26, acceptable action.

However, GCRTA's long-term failure to restore and maintain the capability of the ATS portion of the Red Line system before the accident suggests that GCRTA was satisfied to operate its system with a degraded ATS, despite its response to Safety Recommendation R-77-26. Testimony obtained and evidence developed during the course of this investigation tends to support this position.

2/ Railroad Accident Report -- "Head-on Collision of Two Greater Cleveland Regional Transit Authority Trains, Cleveland, Ohio, July 8, 1977"(NTSB/RAR-78-2).

Another important causal factor in the 1977 head-on collision in Shaker Heights was GCRTA's failure to keep vegetation from obscuring vision in a 60° curve. In its report of the investigation of that accident, the Safety Board found that the vegetation on the inside of the curve prevented the motormen of the trains from seeing the opposing train in time to stop. The Board's finding that the vegetation was a contributing factor in the probable cause of that accident apparently has not motivated GCRTA sufficiently to produce an ongoing program of vegetation control at critical sight distance locations along its rail lines.

In the accident of July 10, 1985, the operator of train No. 6601 could have stopped his train short of the stalled train despite GCRTA's poor maintenance of the vegetation had he been alert and attentive to his job. However, the Safety Board believes that had the view around the curve not been masked by foliage, the operator of train No. 6601 would have had a clear view of train No. 6614 in time to stop his train clear of it, even if his recognition of the danger and his response to it were slower than normal.

The operators of both trains indicated that the trip arms of intermediate signals can be "knock[ed] down"; that is, the trip arm is lowered when a train approaches the signal slowly. This enables trains to be operated through signals displaying "stop" aspects. Further, the trip arm at the interlocking signals can be lowered by pushing a button on the signal mast, which can be reached through a window at the right front of the train. The clear implication of the testimony was that the procedure of defeating the trip arm to proceed through "stop" aspects of signals was being practiced on the Red Line. This practice can condition operators to believe that the strict adherence to or compliance with the aspects displayed by the signals is not absolutely necessary to the safe operation of the system. This "mind set" would be reinforced if the operating employees believed that GCRTA management condoned the practice.

Further, the operating rules for compliance with the signals require the operators to call the control tower supervisor whenever they reach a signal (either an interlocking or an intermediate block signal) with a "stop" aspect displayed. In testimony provided to the Safety Board by the operators of trains No. 6601 and No. 6614 and in direct observation while riding trains of the Red Line, Safety Board investigators learned that when operators contact the tower control supervisors in such situations, the supervisors will often tell the operators to pass the signals and proceed on line of sight.

This permission to proceed through a signal displaying a "stop" aspect and to operate on line of sight has been given at signals with trip arms functioning and at signals with trip arms not functioning. Further, the operator of train No. 6601 stated

in testimony to the Safety Board that he had been instructed by the tower control supervisors to proceed through stop "aspects," describing the process of "knocking-down" the signal and then closing "up to the other train". In fact, in response to a question of whether he was always told to close up on trains in front of him, he replied "yes". Additionally, the tower control supervisor on duty at Cleveland Union Terminal at the time of this accident testified, in great detail, on how to tie down the trip arm of an intermediate block signal in order to proceed through red signals into "stop" blocks. Operating personnel could interpret this action by GCRTA supervisory personnel as tacit approval of a policy that strict compliance with signal aspects and with operating rules is not necessary for safe operations.

In addition to the disregard for operating rules, the GCRTA's failure to maintain the signal system could well have reinforced the employee "mind set" that strict compliance with the rules was not an absolute necessity. It appears that GCRTA had created a situation in which, at the least, the ATS portion of the Red Line system was not being operated under its signal rules, but rather, under a hybrid operation that was neither a signalized nor a manual block operation. The method of operation had become a "permissive block operation".

Unfortunately, however, GCRTA was not adequately structured to provide the safeguards necessary to operate the ATS portion of its Red Line system safely under a permissive block operation. Train operators, conductors, and tower control supervisors were not provided adequate procedures and equipment. A prime example is that GCRTA operating rules addressing this type of operation were confusing, ambiguous, and lacking in specific guidance. GCRTA's "Operation on Sight" specifically permits following an operation within blocks (that is, operation of two trains within the same block under certain conditions), or permissive block operation. However, under the provisions of these rules, an operator must keep a minimum distance of 1,000 feet between his or her own train and a preceding train.

Red Line signal blocks are typically longer than 1,000 feet; the block in which the accident occurred was nearly 1,600 feet long, and with signal EW 263 out of service, the first block east of West 117th Street Station was 2,400 feet long. However, many Red Line locations, like that at which the accident occurred, have available sight distances of less than 1,000 feet. The GCRTA's rules are silent on what operators should do in this situation. The "line of sight" rule leaves the issue of speed under these conditions entirely to the operator's judgment. None of the train crewmembers, tower supervisors, and training supervisors, nor the safety supervisor or the rail superintendent, who were questioned by Safety Board investigators in deposition proceedings, was able to explain adequately the

rules regarding "operation on sight" and operating on "line of sight", nor could they explain how an operator could comply with the 1,000-foot requirement where forward vision was less than 1,000 feet.

In addition to the ambiguous rules, GCRTA did not provide the tower control supervisor at Cleveland Union Terminal with a modelboard that covered the system west of West 38th Street. A modelboard that located trains at all times would be essential to the safe operation of any system operated in less than strict adherence to its signal rules.

The communication procedures of the Red Line system were also inadequate for this type of block operation. Statements by tower control supervisors and observations by Safety Board investigators of communications between operators and supervisors revealed that these communications are generally limited to requesting and receiving permission to proceed into "stop" blocks or for emergency purposes. In general, the tower control supervisors do not know the locations of trains at any given time precisely enough to operate a permissive block operation safely.

However, the practice of operating its systems with less than strict adherence to rules adequate for the safe operation of its system is not new to the GCRTA. In its investigation of a 1976 rear-end collision on the Red Line 3/, in which 20 persons were injured, the Safety Board found that GCRTA had no method to ensure that an operator would stop his train before moving past the second stop signal protecting the rear of a preceding train. The investigation also found that the ATS system was compromised by the practice of allowing a train to approach and pass a stop signal slowly enough to drop the trip arm from the tripping position. The Safety Board also determined that contributing to the probable cause of the accident was "...the ineffectiveness of the protective devices and procedures to prevent a following train from entering an occupied block."

As a result of its investigation, the Safety Board issued, on August 19, 1977, Safety Recommendation R-77-21, in which it recommended that GCRTA "Operate trains on an absolute block. If it becomes necessary to enter an occupied block in an emergency, provide procedures that will insure safe operations." On November 18, 1977, GCRTA responded that,

Trains now operate on an absolute block. When it is necessary to enter an occupied block, in an emergency, permission must be received from the tower control supervisor.

3/ Railroad Accident Report--"Rear End Collision of Two Greater Cleveland Regional Transit Authority Trains, Cleveland, Ohio, August 18, 1986" (NTSB/RAR-77-5).

Subsequently, GCRTA informed the Safety Board that it had issued a bulletin rule applying to all red stop blocks that required trains to

stop short of red block, remain standing for 30 seconds, and then call the tower control supervisor for permission to enter the block. If permission is received, speed within the block shall be no more than 10 mph.

Because of GCRTA's response, the Safety Board closed out the Safety Recommendation on a "Closed--Acceptable Alternate Action" basis. However, when the bulletin rule was incorporated into GCRTA's new book of operating rules issued February 28, 1978, the 10-mph speed restriction was not included. It is possible that GCRTA did not include in its 1978 operating rules the 10 mph speed restriction for trains permitted to operate into a red stop block because it believed the 10 mph limit would not be needed in some portions of its system where sight distance would allow adequate distance to stop. GCRTA may have believed that this limit was too restrictive, which may be true where sight distance is 1,000 feet. Certainly with the deceleration capabilities of the cars being operated in this accident, an alert operator can safely stop a train in far less than 1,000 feet.

The Safety Board's investigation revealed that instead of being restricted to a relatively slow specified speed, GCRTA train operators have been permitted to proceed past red signals entirely on the basis of their own judgment and in line with GCRTA's unique "line of sight" speed rule with its attendant uncertainties. GCRTA continued to rely on the use of a permissive block operation with trains routinely allowed to pass stop signals. The result is total dependence on human management of its trains, even when tower control supervisors have no modelboard indications of train locations. These facts indicate that GCRTA was operating the Red Line on a basis of "close-up" or expedited train movement.

It is also clear that it is unsafe for train operators to have no guidance regarding the maximum speed at which they should operate their trains in areas where the sight distance is limited, such as in the "S" curve where this accident occurred. This accident may have been avoided had an adequate speed limit been posted at a distance from the curve appropriate for the sight distance, train braking capabilities, and human reaction and response time.

The manner in which the GCRTA operated its Red Line system --- its failure to enforce strict compliance of its operating rules, its failure to maintain the signal system, its adoption of confusing and ambiguous operating rules -- produced an

environment in which a permissive block operation existed. This may have been the unintentional result of GCRTA management's failure to direct attention or resources to these problems. However, it may also have been the result of a conscious management decision to operate the system on an "expedited" or "keep-the-trains-running-up-close" basis. Whichever is the case, the inevitable result of such a method of operation is degraded safety and accidents like this one.

The results of this method of operation appear, indeed, to increase the number of accidents. Safety Board investigators determined that there had been no serious train accidents involving operator non-compliance with restrictive signal aspects during the 20 years in which the Cleveland Transit System operated the Red Line and during the 33 years in which the city of Shaker Heights operated what are now GCRTA's Blue and Green Lines. However, since GCRTA took over these rail lines in 1975, the Safety Board has investigated six collisions and one derailment involving passenger-carrying trains on these lines. Passengers were injured and there was substantial damage in each of these accidents.

The Safety Board believes that GCRTA will continue to experience accidents involving non-compliance with restrictive signal aspects with consequent peril to the public until it addresses its permissive block procedures. GCRTA must place safety before operational expediency and establish and enforce safe operating procedures that leave no doubt as to precisely what is required on the part of its train operators. Automatic train control may lessen the human management factor as long as it is functional, but a responsible approach to operation when the automatic train control is non-functional will still be needed. Moreover, as far as the Safety Board has been able to learn, no program is presently underway to replace the existing ATS system with automatic train control on the east side portion of the Red Line.

Despite GCRTA assurances of improvements in training, retraining, and supervision, the Safety Board is concerned that serious deficiencies remain in these important functions. As a result of its investigation of the 1976 Red Line head-on collision, on August 19, 1977, the Safety Board issued Safety Recommendation R-77-20, in which it recommended that GCRTA:

Develop a system assurance and safety program that will provide and insure the following:

- 1) A set of operating rules and procedures that will provide objective requirements for a safe and efficient operation.

- 2) A training program that will originally acquaint operating personnel with the rules and a system of reexamination to keep them current with the rule requirements.
- 3) A system of supervision which will enforce the rules and will provide an efficient operation.

GCRTA responded to the Safety Board that it drafted and issued to its employees a book of operating rules in February 1978. GCRTA also informed the Safety Board on November 18, 1977, that it had "developed an outline of the basic operator training procedures along with a schedule of the succeeding reviews and an annual examination to keep them current with the rule requirements," and had "implemented a system of supervision which will enforce the rules through proficiency testing". As a result, the Safety Board closed Safety Recommendation R-77-20 as "Acceptable Action" on March 22, 1979.

Although GCRTA may be providing more thorough initial training of its new operators than it had in the past, the results of the Safety Board's investigation of this latest accident suggest that GCRTA did not accomplish all it said it was going to do, especially in regard to the training of its operators who had been with the company prior to the establishment of the improved training procedures. Both train operators involved in this accident had been operating trains since the early 1970's and had received the Cleveland Transit System 5-day course and on-the-job training at the time they were qualified. Nevertheless, the operator of train No. 6601 stated that he had never been trained or examined by GCRTA on the 1978 book of operating rules and could not recall having received any GCRTA annual "refresher" training and examination. The operator of train No. 6614 stated that he had attended a 1-day training session when he received the rules and again when the rules were revised in 1980. GCRTA service records did not contain any information on the rules training that the operators may or may not have received.

GCRTA may believe that its older, more experienced operators (those who have been with the system since the training was improved) are sufficiently competent and that its training resources should be concentrated on new rail operators. However, testimony given to the Safety Board clearly demonstrated that both operators, despite their experience, were unsure as to the meaning of a number of important operating rules.

Further, the Safety Board is concerned that GCRTA's leading training supervisor incorrectly defined the "line of sight" rule, which is relied on almost entirely when trains enter occupied

blocks. Certainly if the teacher does not understand the subject matter, there is little reason to believe that he will be able to explain it adequately to his students.

The Safety Board is also concerned with the adequacy of GCRTA's supervisory oversight. Although the training officer related that he, his assistant, and other supervisors often rode with train operators to assess their proficiency, this testimony was corroborated neither by written records nor by the testimony of the operators and conductors who were interviewed. Although it appears that GCRTA platform supervisors, who were primarily promoted train operators, did routinely check train crew performance, the checks appear to have been confined to largely non-safety concerns, such as leaving stations ahead of schedule and ensuring that passengers pay fares. If operators were checked for compliance with lineside signals and other operating procedures, no records of such checks were provided to Safety Board investigators.

It also appears that GCRTA's safety department was not effective in overseeing rail training and operational performance. The safety department was unable to provide sufficient resources to the rail rapid transit operations, had limited authority to make changes, had limited time with trainees, was improperly staffed, and was not oriented toward the prevention of operational safety problems.

As previously noted, the GCRTA did not, as it told the Safety Board it would in its response to Safety Recommendation R-77-21, incorporate in its new book of operating rules a protective speed restriction imposed on trains permitted to pass stop signals. GCRTA's action in this case is not an isolated incident. On September 14, 1978, the Safety Board closed another Safety Recommendation, R-77-22, as acceptable action when the GCRTA indicated that operators were required to sign the bulletins. However, contrary to that response, testimony presented at deposition proceedings indicates that the operator of train No. 6601 did not and was not required to sign the safety bulletin regarding the 5 mph speed restriction. Thus, GCRTA was not operating as it told the Safety Board it would operate.

Accidents involving the Greater Cleveland Regional Transit Authority first alerted the Safety Board to the need for continual oversight and regulation of the rail rapid transit operations of regional transit authorities. Although the actions that GCRTA indicated it had or was taking appeared to be responsive to most of the Safety Board's recommendations of 1977 and 1978, they did not actually resolve the problems at Cleveland before the investigation of this accident. GCRTA has continued

to experience passenger-injury-producing collisions and derailments caused by improper operating practices since passage of the National Mass Transportation Assistance Act of 1974.

These accidents, and GCRTA's failure to carry through with the Safety Board's recommendations, indicate that GCRTA needs oversight by an independent agency. In 1978, and later in 1981, the Safety Board recommended that the Department of Transportation get involved in the regulation of the safety of rail rapid transit systems that receive Federal funds. The DOT rejected these recommendations and the Safety Board subsequently reconsidered the 1981 recommendations and closed them. However, the Safety Board also told the DOT that it should not totally abdicate its role in the safety of rail rapid transit systems.

Although the DOT has retained the authority to investigate potentially unsafe conditions, to require corrective action, and to withhold financial assistance if a corrective plan is not implemented, the Safety Board has seen little evidence that DOT is inclined to use this authority. In January 1987, the Safety Board wrote to the Secretary of DOT stating this concern.

The experience of the New York City Transit Authority (NYCTA) illustrates how such a corrective plan might be carried out. After conducting a special investigation of the safety of the New York City Transit Authority in 1981, the Safety Board on September 22, 1981, recommended that the State of New York take legislative and/or executive action to authorize a new or existing independent agency to oversee and regulate the safety of the NYCTA system. Subsequently, the State established the New York State Public Transportation Safety Board, empowered to oversee and regulate rail rapid transit lines in the State. Before that, the State of California had also established an agency that actively regulated rail rapid transit systems.

Insofar as the Safety Board has been able to determine, the State of Ohio Public Utilities Commission (PUCO) presently has no oversight or regulatory authority over GCRTA. GCRTA's management has shown little inclination to exercise the safety oversight necessary to provide a high degree of confidence that its rail rapid transit system will be operated safely. The limited resources and authority given to its safety department is further support for this conclusion. The Safety Board believes there is adequate precedent for PUCO or another Ohio agency to oversee GCRTA, and the Safety Board further believes the public welfare and interest would be enhanced if the State of Ohio were to take the necessary steps to accomplish this.

Therefore, the National Transportation Safety Board recommends that the Greater Cleveland Regional Transit Authority:

Require absolute block operation whenever Automatic Train Control or Automatic Train Stop are not functional. (Class II, Priority Action) (R-87-05)

Modify the rail operations rule book to specify, for conditions requiring the operation of a train past a stop signal, a maximum restricted speed that would enable the train to be stopped short of a standing train, a broken rail, or any other hazard. (Class II, Priority Action) (R-87-06)

Modify the radio rules to require, when hazards such as a disabled train exist, tower control supervisors to notify the operators of following trains and trains on adjacent tracks of the hazard and prohibit them from entering that block without specific authority to do so. (Class II, Priority Action) (R-87-07)

Perform and document frequent supervisory checks using a systematic procedure to determine if train operators are complying with the operating rules including speed restrictions and signal rules. (Class II, Priority Action) (R-87-08)

Make periodic inspections as necessary and maintain an adequate parts inventory to keep of its wayside signal system, including the Automatic Train Stop apparatus, functional at all times. (Class II, Priority Action) (R-87-09)

Periodically train and examine all rail train service employees and rail supervisors on the operating rules, operating procedures, and bulletin instructions. (Class II, Priority Action) (R-87-10)

Issue and provide to each train operator and tower control supervisor, a rail safety bulletin advising of a signal system failure or malfunction, such as a broken trip arm or inoperative signal, each time such occurs if the failure or malfunction cannot be repaired immediately. (Class II, Priority Action) (R-87-11)

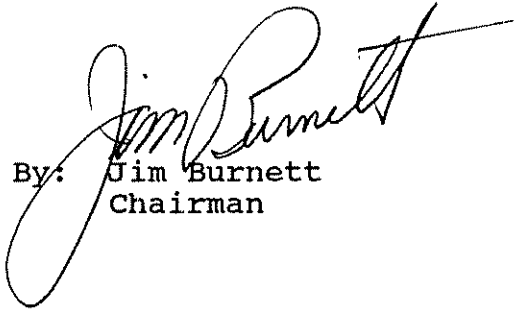
Post, in all areas of the system in which sight distance is less than 1,000 feet, signs displaying restricted speeds, based on the sight distance available and distance required to stop the trains to provide adequate distance to stop a train in the event it does enter an occupied block. (Class II, Priority Action) (R-87-12)

Establish a positive means to determine that speed restriction signs posted because of specific lineside problems, such as track irregularities, remain posted. (Class II, Priority Action) (R-87-13)

(A separate letter containing Safety Recommendation R-87-04 has been sent to the Governor of Ohio recommending State oversight of rail rapid transit systems within the State of Ohio.)

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "... to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations R-87-05 through -13 in your reply.

BURNETT, Chairman, GOLDMAN, Vice Chairman, and LAUBER and NALL, Members, concurred in these recommendations.


By: Jim Burnett
Chairman