



# National Transportation Safety Board

Washington, D.C. 20594  
Safety Recommendation

119# R-584/A

**Date:** October 16, 1987

**In reply refer to:** R-87-52 through -54

Mr. William Dempsey  
President and Chief Executive Officer  
Association of American Railroads  
50 F Street, N.W.  
Washington, D.C. 20001

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At 4:25 p.m. e.d.t., on July 8, 1986, 15 cars of a southbound Baltimore and Ohio Railroad Company freight train consisting of 44 cars and a locomotive, derailed while traveling at 45 mph near Miamisburg, Ohio. Three of the 15 derailed cars were tank cars containing yellow phosphorus, molten sulfur, and tallow. While derailing on a bridge, these tank cars were extensively damaged, lost product, and were involved in the resulting fire. Approximately 7,000 residents from a section of Miamisburg were initially evacuated as a safety precaution.

On the following day as a wreckage-clearing crew contracted by the railroad was preparing to remove the smoldering phosphorus tank car, a concrete structure supporting the tank car collapsed and several hundred gallons of molten phosphorus inside the tank car escaped and ignited, resulting in an extensive cloud of phosphorus combustion effluents. During the next 48 hours, a 3-square-mile area of Montgomery County, Ohio, was evacuated, forcing an estimated 30,000 people to leave their homes and businesses; 569 persons were treated for various complaints during the incident. Total property damage was approximately \$3,540,000, including the cost of hazardous materials cleanup. 1/

The phosphorus tank car, which was equipped with airbrake attachments welded directly to the tank, derailed on the bridge. This allowed the tank car's airbrake equipment, which was closer to the ground than any other tank car tank appurtenance, to impact with debris and the ground. These impact forces then were transferred through the airbrake support directly to the tank shell which tore the tank car open and thereby release large amounts of phosphorus. The other two tank cars that derailed had the airbrake equipment attached to the draft sill rather than directly to the tank. These derailed without either of them experiencing bottom tears in the tank shells as a result of attachment failures.

1/ For more detailed information, read Hazardous Materials Accident Report--"Hazardous Materials Release Following the Derailed of Baltimore and Ohio Railroad Company Train No. SLFR, Miamisburg, Ohio, July 8, 1986," (NTSB/HZM-87/01).

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The major breach of the phosphorus tank car through which 75 percent of the liquid phosphorus was released immediately after the derailment could have been avoided had airbrake attachments been connected to the draft sills or attached to the tank car by a properly designed bottom reinforcing pad. In addition, had the airbrake support been designed to break away before allowing the transfer of forces that tore the tank shell, this bottom breach in the tank likely would not have occurred.

The Association of American Railroads (AAR) previously recognized the hazards posed to tank cars during derailments by bottom fittings and attachments. The National Transportation Safety Board is pleased that the AAR now has required that all tank cars in hazardous materials service equipped with brake support attachments welded directly to tank shells be retrofitted by 1992. During this 5-year period, tank cars transporting the higher hazard commodities are being retrofitted first. However, in the AAR's decision in 1977 not to include protection for bottom attachments in its bottom outlet protection program, the AAR missed an early opportunity to address this safety problem as it was aware that such attachments could rupture tanks during derailments just as bottom outlets. Had the AAR reviewed the circumstances of the previous recorded failures, perhaps it would not have discounted the need to protect these attachments. Additionally, the Federal Railroad Administration (FRA) had no part in this decision not to include protection for bottom attachments since it was not determining the adequacy of actions taken by the AAR or determining their affect on public safety.

When the need for reinforcing pads was first recognized by the AAR in 1971, no design engineering evaluation was made to determine the adequacy of this proposed modification to tank cars. The initially required 1/4-inch pad thickness was determined to be inadequate only after fatigue failure separations began occurring during normal operating conditions. Even after the AAR learned that its requirements for pad designs were deficient, it did not inform the FRA that the the Federal standard was deficient. Rather, it depended on tank car manufacturers to voluntarily install thicker pads.

Other investigations by the Safety Board and by the Canadian Transport Commission (CTC) have raised concerns about the effect on tank car crashworthiness due to attachment designs, materials, and quality control used in making welded attachments to tank cars. On April 4, 1985, a leaking anhydrous ammonia tank car was discovered at the Burlington Northern Railroad Balmer Yard in Seattle, Washington. Inspection of the tank head by the Safety Board determined that a brittle fracture had developed in an area adjacent to the reinforcing pad. Metallurgical tests determined that the fracture resulted from the quality of the fillet weld at the stub-sill to reinforcing pad connection and the low temperature brittle properties of the steel used for the pad and tank head. Following this incident, the tank car manufacturer identified reinforcing pad cracks in at least 28 similarly manufactured tank cars and replaced the reinforcing pads with a fine-grain steel which had improved low temperature brittle properties. Additionally, the car company equipped several hundreds of its cars with 9- by 13-inch removable plates on the jackets to facilitate periodic inspections of the welds on the reinforcing pads during the service life of the tank cars. All remedial action has been left to the tank car manufacturer with the FRA and AAR collecting data on the operating experience to determine if additional action is necessary.

On January 4, 1986, a sulfuric acid tank car was discovered leaking in the Canadian National Yard in Cambellton, New Brunswick, Canada. The tank shell, made from steel displaying low temperature brittle properties, developed a brittle fracture in an area adjacent to the reinforcing pad resulting in the leak. Of concern was the quality of the fillet weld at the stub-sill to reinforcing pad connection and the low temperature brittle properties of the steel from which the pad and tank head were made. The investigation

conducted by CTC concluded that American Society for Testing and Materials (ASTM) 515 steel, as presently permitted in its and the FRA regulations, is not an adequate material for the manufacture of tank cars. Further, the CTC revised its "Regulation for the Transportations of Dangerous Commodities by Rail" to require the use of ASTM 516 steel for newly built tank cars used or manufactured in Canada.

The Safety Board is concerned about the longer term implications of these findings to other tank car manufacturers who may be using similar procedures and materials. Consequently, the FRA and the AAR are urged to implement an overall assessment of the problems being experienced with attachments to tank cars and to determine the adequacy of the design, quality control standards, and practices to identify improvements necessary in existing design and manufacturing standards and to develop and implement necessary modifications for existing tank cars.

After this review of the FRA, AAR, and the CTC processes for developing tank car safety standards and for identifying deficient conditions and acting to remedy those conditions, it is clear to the Safety Board that voluntary industry actions, rather than FRA actions, have had the most effect on the safety standards of tank cars. This is a result of delegating this responsibility to the AAR. In so doing, the FRA and the CTC have failed to established any substantive control over the AAR's implementation of the delegated authorities, have not established substantive reporting requirements concerning actions taken by the AAR, and have not established or implemented a comprehensive program for periodically monitoring the actions taken on behalf of the respective governments.

Before the FRA was responsible for public safety with respect to transporting hazardous materials by tank car, the AAR had established procedures for developing design standards and for controlling the safety of tank cars. When the responsibility for tank car safety was delegated by the Secretary of Transportation to the FRA or during the 20 years after, the FRA did not objectively act to assess the adequacy of the AAR's implementations of a major safety regulatory program. Had it done so, the FRA would have learned that the AAR had knowledge of many tank car deficiencies and had not informed the FRA. The FRA would also have discovered that the Tank Car Committee provided a great opportunity for chemical manufacturers and tank car owners to control many key decisions affecting transportation safety and provided little or no opportunity to specifically identify or consider public safety concerns.

The Safety Board notes that voluntary industry efforts taken through the Tank Car Committee generally have been good and generally have resulted in appropriate action for improving tank car safety. However, through such control, chemical manufacturers and tank car owners also are capable of influencing decisions on matters pertaining to safety, such as tank car retrofits and tank designs, by giving undue consideration to the economic impact on tank car owners and shippers and thereby adversely impact the safety of railroad operations and public safety. Even though well intended, the Safety Board does not agree with the AAR that its industry-oriented membership on the Tank Car Committee can in all cases give fair representation to public safety concerns.

The removal of full center sills from beneath tank cars and the development of stub-sill tank cars without appropriate consideration as to the effect of this design change on the railroads and public safety is a prime example of such influence. The center sill withstood the buff forces generated during train movements, provided a safe location for attaching car equipment such as air brake reservoirs, and provided protection during derailments for tank discontinuities such as bottom fittings and outlets. Since removal of

the center sill, the investigations of derailments have revealed many needed safety improvements in the design of stub-sill tank cars for attachment methods and for protection of bottom discontinuities. Because the FRA took no part in the Tank Car Committee deliberations on the design of stub-sill cargo tanks and because public participation in these deliberations was not otherwise achieved, decisions were made without the public safety interests being independently identified and supported.

Had the FRA required the AAR to report any actions taken or to identify specific tank car failures, the FRA would have been alerted earlier about the numerous and varied types of attachment failures. These failures were documented by the AAR during investigations of derailments of stub-sill tank cars and through AAR-required applications and Report of Repairs, R-1. Further, the FRA should have recognized that the AAR had not developed and implemented a program for the periodic and thorough analysis of this failure data in order to identify failure trends among the classes and builders of tank cars. Earlier recognition of this problem should have induced the FRA to require protection of all bottom attachments and fittings rather than accepting the retrofit protection program of the AAR. Had the FRA reviewed the actions taken by the AAR concerning attachments, it also would have become aware that the present requirement of FRA for installing pads between attachments and tank shells, made in 1971 in response to an AAR petition, was not adequate.

The FRA should have implemented an aggressive program for identifying and assessing the adequacy of the actions taken by the AAR when it first delegated the authority for tank car safety. This program could have identified the imbalance on the Tank Car Committee and then it could have recognized the potential adverse effect this imbalance could have on tank car designs. The FRA easily could have determined that the engineering expertise for the design of tank cars resided almost exclusively with the Railway Progress Institute member and some of the trade organizations. Additionally, since the individual railroads are responsible for the losses which occur during transportation, the FRA should have questioned how this arrangement could meet the railroad industry's safety needs for the development of tank car standards much less the needs of public safety.

Thousands of tank cars in violation of FRA specifications were identified as a result of the Safety Board's investigation of the accident on December 31, 1984, at North Little Rock, Arkansas; yet the FRA did not take effective action to ensure that proper corrective actions were taken. If the FRA had been monitoring the AAR actions, it would have become aware more quickly of the inappropriate actions being taken by General American Transportation Corporation (GATX) and that these actions were being approved by the Tank Car Committee. Because the FRA did not monitor the AAR actions, the FRA was not aware that the AAR had approved GATX's initial application for retrofitting the noncomplying cars in violation of FRA tank car specifications. Today, the adequacy of the actions approved for retrofitting these tank cars remains unresolved and awaits the results of research and experience during the operation of the retrofitted tank cars.

Another issue identified during this review and still requiring resolution by FRA action was that the regulatory agencies charged with tank car safety responsibilities both in the United States and in Canada have not formally established procedures for exchanging information on tank car performance. There are no periodic meetings to exchange views and concerns about safety improvements for tank cars or to improve the operations of the AAR under the delegated authorities of both countries. The need for planned, periodic exchanges of information and views about matters of common concern is crucial. Since both countries apply the same standards to tank car design and both countries have delegated responsibilities to the AAR, it would be beneficial and practical to coordinate efforts.

While the AAR has recently implemented changes in its operations to exert greater railroad industry influence on decisions made by the Tank Car Committee, to open many of its records for review by appropriate governmental agencies, and to allow government regulatory agencies to attend portions of its meetings, the Safety Board does not consider these actions adequate if the AAR is to meet public safety interests. Using both the findings from this Safety Board review and from the FRA audit of AAR procedures, the FRA now must develop regulations and establish program objectives, procedures, reporting requirements, and determine that public safety interests relative to tank car safety are being adequately served. Among the many actions necessary, the FRA needs to establish procedures detailing the manner in which the Tank Car Committee must conduct this delegated public business, the qualifications of persons who serve on the Tank Car committee, the mix of interests represented on this Committee including the need for public-at-large members, the types and extent of records that must be maintained, the requirements for periodic reports to the FRA, the identification of the types of analyses which must be performed of tank car repair records and the frequency of performing these analyses, the conditions under which the retrofit of existing cars must be undertaken, and the provisions for FRA representatives to monitor any and all activities associated with actions taken by the Tank Car Committee. The FRA should coordinate its actions with the CTC to take advantage of its experience and concerns and to promote the development of a single program capable of meeting the safety needs of the United States and Canada.

As clearly pointed out by the Canadian Royal Commissioner following the CTC MacMillan Yard Inquiry, public participation in the Tank Car Committee deliberations affecting public safety is needed. The Safety Board concurs. The FRA should insure that the public safety needs are identified and supported in all of the FRA delegations to the AAR. Such an objective would insure that both the safety interest of the rail industry and the public are met.

Therefore, as a result of its investigation, the National Transportation Safety Board recommends that the Association of American Railroads:

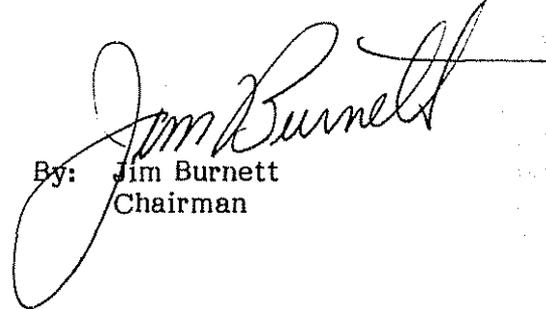
Determine through analysis of its "Reports of Repairs" records the causes of tank car attachment failures. (Class II, Priority Action) (R-87-52)

Revise present attachment standards for new tank cars and require appropriate modification of existing tank cars based on deficiencies identified in its analysis of the causes of tank car attachment failures. (Class II, Priority Action) (R-87-53)

Establish a quality control program that includes on-site inspection to determine that tank car manufacture, repairs, modifications, and alterations are performed in compliance with the tank car specifications approved in applications. (Class II, Priority Action) (R-87-54)

Also as a result of its investigation, the Safety Board issued Safety Recommendations R-87-46 through -51 to the Federal Railroad Administration and R-87-55 and -56 to CSX Transportation and reiterated Safety Recommendation I-81-1 to the Department of Transportation.

BURNETT, Chairman, and LAUBER, NALL, and KOLSTAD, Members, concurred in these recommendations. GOLDMAN, Vice Chairman, did not participate.

A large, stylized handwritten signature in black ink, appearing to read "Jim Burnett". The signature is written over the typed name and title.

By: Jim Burnett  
Chairman