



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

LOG R-650F

Date: March 2, 1995

In reply refer to: R-95-20

Mr. Robert A. Matthews
President
Railway Progress Institute
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On June 6, 1994, a conductor for the Norfolk Southern Railway Company detected product leaking from the bottom of tank car UTLX 79211 in the Norfolk Southern Harry deButts yard in Chattanooga, Tennessee. The tank car contained 12,184 gallons of a 75-percent concentration of arsenic acid, which is classified as a poisonous material and also designated as a marine pollutant under the Department of Transportation (DOT) Hazardous Materials Regulations.

A total of 3,079 gallons of arsenic acid was released from UTLX 79211. An undetermined amount of the arsenic acid entered the storm drain system for the yard. Although the sluice gate for the storm drain system was closed, arsenic-contaminated water from the storm drain system was discharged into Citico Creek about 1 1/2 miles upstream of the mouth of the creek into the Tennessee River. The intake pipes for the city's municipal water supply cross the mouth of the creek and extend about 175 feet into the Tennessee River. Cleanup, containment, and disposal costs were estimated at \$8.77 million as of January 31, 1995. There was no evacuation, and no injuries were attributed to the release.¹

The tank car involved in the release of arsenic acid was tank car UTLX 79211, a DOT specification 111A100W1 tank car, built by the Union Tank Car Company (Union) in March 1966. The tank car was owned by Union but was leased to Koppers Company, Inc., on March 31, 1988. The Hickson Corporation (Hickson) assumed operational control of the tank car in February 1989. Since that time, Hickson used UTLX 79211 to ship arsenic acid; prior to the accident on June 6, 1994, the tank car

¹ National Transportation Safety Board. 1995. Tank car failure and release of arsenic acid in Chattanooga, Tennessee, on June 6, 1994. Hazardous Materials Accident Report NTSB/HZM-95/01. Washington, DC.

was used for shipments of arsenic acid in July and October 1993 and March and April 1994. Hickson leased eight other tank cars from Union for arsenic acid service, but it did not own or lease any additional tank cars.

Although UTLX 79211 had a bottom outlet valve, Hickson transferred arsenic acid to and from the tank car through a 2-inch-inner-diameter (2.4-inch-outer-diameter) grade 316L stainless steel eduction pipe. The top of the eduction pipe was bolted to a 13-inch-inner-diameter housing that was welded to the top center of the tank car. The eduction pipe extended downward from the housing to the bottom of the tank, a distance of about 112 inches. Valves and fittings for transfer operations were located at the top end of the eduction pipe. A dome-shaped cover was attached to the exterior of the housing to shield the valves and fittings. The middle of the eduction pipe had a slight bend in the plane of the longitudinal centerline of the tank car. (In the event that the tank car would be subjected to compressive forces in an accident, the eduction pipe would deform and collapse at the bend rather than act as a rigid pipe that could puncture the tank shell.)

The bottom of the eduction pipe was held in position by a saddle-shaped pipe guide that was welded to the bottom of the tank. The pipe guide, which was about 13 inches wide at its base and 5 inches high, was designed to be positioned directly below the opening for the eduction pipe in the housing at the top of the tank car and symmetric to the centerline of the tank car. A small length of 3-inch-inner-diameter pipe with a flared end was welded to the top of the saddle-shaped guide. The eduction pipe extended through the small length of 3-inch pipe.

A bowl-shaped sump about 6 inches in diameter and 3 inches deep was welded to the bottom of the tank about 2.75 feet toward the B-end from the middle of the tank car. According to Union's design drawings, the sump was to be concentrically centered below the pipe guide. The bottom end of the eduction pipe was also to be concentric to the sump and to extend slightly beyond the inside bottom of the tank into the sump.

In March 1988, Union, at the request of Koppers, modified the eduction system in UTLX 79211 by replacing the original 3-inch-diameter eduction pipe with the 2-inch-diameter eduction pipe. The original eduction pipe guide was also replaced. The sump and the housing at the top of the tank car were not replaced and were installed when the tank was constructed.

Safety Board investigators first examined the tank car on July 23 at the deButts yard in Chattanooga.² When Safety Board investigators examined the tank

² The Safety Board initiated an investigation after a Safety Board investigator learned of the circumstances of the accident on July 19, 1994, while attending a meeting of the Association of American Railroads' Tank Car Committee. Initial information indicated that the spill of arsenic acid
(continued...)

car, the jacket and insulation on the bottom of the tank car had been removed along the length of the tank car inboard of the trucks to expose the tank shell, including the sump and bottom outlet valve. An oval-shaped hole was observed at the interface between the bowl-shaped sump and the bottom of the tank at the bottom centerline facing the A-end of the tank. The hole was about 1 inch long and 0.25 inch to 0.50 inch wide at its widest point.

UTLX 79211 was moved to Lynchburg, Virginia, where external and internal examinations of the tank car were performed on September 7, 1994. The internal examination of the tank car revealed an area of corrosion where the sump was welded to the tank at the bottom centerline of the tank car. The hole observed during the external examination of the tank car was located within this area of corrosion. The corroded area formed an arc about 3 inches long and extended through the tank shell to create the hole.

The internal examination of the tank car also revealed that the alignment of the saddle-shaped pipe guide was not concentric to the sump, which had an inside diameter of 5.75 inches. The distance from the exterior side of the eduction pipe to the edge of the sump along the centerline of the tank car was 0.35 inch toward the A-end and 3.0 inches toward the B-end. With the eduction pipe positioned in the pipe guide, there was enough longitudinal movement of the eduction pipe toward the A-end and the area of corrosion to extend at least 0.1 inch beyond the edge of the sump.

The alignment of the housing located at the top of the tank car with the sump was checked by measuring the vertical alignment of the eduction pipe. Measurements indicated that the eduction pipe, over a 5-foot section of its length, was vertically misaligned in both the longitudinal and transverse planes by 0.25 to 0.50 inch.

Because of the misalignment between the sump and the housing for the eduction pipe at the top of tank car UTLX 79211, the eduction pipe was not concentrically positioned with the sump as it was designed to be. As previously noted, the clearance between the eduction pipe and the edge of the sump in the corroded area was about 0.35 inch. If the 2.4-inch-outer-diameter eduction pipe had been concentrically aligned with the sump (inside diameter of 5.75 inches), the clearance should have been 1.675 inches.

Further, the lower end of the eduction pipe that was facing the corroded area of the sump was slightly deformed and abraded in a manner that was consistent with

² (...continued)

had been contained within the yard. When the Safety Board was informed on July 22 that the spill extended outside the yard, investigators from headquarters in Washington, D.C., and the regional field office in Chicago, Illinois, were sent to Chattanooga.

mechanical contact or impact with another object. Given the reduced clearance between the eduction pipe and the edge of the sump, the forces normally encountered in train movement, coupling, and switching operations likely were sufficient to cause movement of the eduction pipe to strike the edge of the sump. Multiple impacts of the eduction pipe against the edge of the sump eventually damaged the phenolic Plasite 3066 coating and compromised its integrity. The arsenic acid penetrated the damaged coating and corroded the steel tank and the sump.

The Safety Board determined that the release of the arsenic acid from UTLX 79211 was caused by misalignment of the sump and the housing for the eduction pipe, which resulted in mechanical damage to the coating of the tank car at the sump and the subsequent corrosion and failure of the tank shell. The inside diameter of the bowl-shaped sump relative to the outside diameter of the eduction pipe did not provide sufficient tolerance to accommodate misalignment between any of the components of the eduction pipe system without causing mechanical damage to the protective coating in the tank car.

Union has indicated that a significant number of its tank cars have the same configuration of sump, housing, and eduction pipe and that this configuration is still an option for newly constructed tank cars. Four of the eight other Union-built and owned tank cars leased to Hickson (UTLX 79204, 79206, 79209, and 75951) had the same configuration of sump, pipe guide, and eduction pipe as UTLX 79211, and all four had similar alignment problems as UTLX 79211, which could have occurred at the time of construction or modifications. The Board is concerned that other Union-built tank cars with this style sump and eduction pipe may have similar alignment problems and be prone to fail in the same manner as UTLX 79211.

Surveys of other tank car manufacturers found that this configuration of sump and eduction pipe system has been used on tank cars for several years and can still be used at the option of the manufacturer. The DOT hazardous materials accident data base indicated that from January 1991 through August 1994 there had been 28 releases of hazardous materials from the sump areas of railroad tank cars (including that from UTLX 79211). Because the DOT data base was not designed to identify the specific mode of failure or the design of the failed component, the magnitude of sump area failures resulting from misaligned components of the eduction pipe housing system cannot be readily determined. The Safety Board is concerned that tank cars built by other manufacturers may also have problems with the alignment of eduction pipes and sumps and eduction pipe bracing systems that could result in mechanical damage to tanks. The alignment problems found by the Federal Railroad Administration (FRA) in 1993 in the 13 tank cars built by the North American Transportation Company and the December 1994 failure of an ACF-built tank car in Newark, New Jersey, in which the rubber lining on the interior of the sump had been worn away sufficiently to expose and corrode the underlying metal sump/tank shell, suggest that tank cars built by other manufacturers do have similar alignment problems. Therefore, the Safety Board believes that the FRA, with the

assistance of the Railway Progress Institute and the Association of American Railroads, should evaluate the failure rate and the mode of failure of bowl-shaped sumps and eduction pipe bracing systems in tank cars transporting hazardous materials, and based on the results of this evaluation, require repairs or modifications to prevent mechanical damage to coatings or linings and subsequently to the tanks.

Therefore, as a result of its investigation of this accident, the National Transportation Safety Board recommends that the Railway Progress Institute:

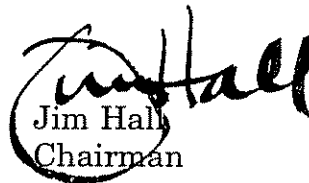
Assist the Federal Railroad Administration with the evaluation of the failure rate and the mode of failure of bowl-shaped sumps and eduction pipe bracing systems in tank cars transporting hazardous materials.
(Class II, Priority Action) (R-95-20)

Also as a result of this accident investigation, the Safety Board issued safety recommendations to the Federal Railroad Administration, the Research and Special Programs Administration, the Union Tank Car Company, the Hickson Corporation, the Norfolk Southern Corporation, Hamilton County Emergency Services, the city of Chattanooga, and the Association of American Railroads.

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 recommendation in this letter. Please refer to Safety Recommendation R-95-20 in your reply.

Chairman HALL, Vice Chairman FRANCIS, and Member HAMMERSCHMIDT concurred in this recommendation.

By:


Jim Hall
Chairman