LOG R-650

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: March 2, 1995

In reply refer to: R-95-9 and -10

Honorable Jolene Molitoris
Administrator
Federal Railroad Administration
Washington, D.C. 20590

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 was used for shipments of arsenic acid in July and October 1993 and March and April

[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.

1994. Hickson leased eight other tank cars from Union for arsensic acid service, but it did not own or lease any additional tank cars.

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.

In April 1988, the Koppers Company had the tank car coated by the Tank Lining and Railcar Repair Company in Butler, Pennsylvania, with Plasite 3066, a baked-on phenolic resin coating. Plasite 3066 is a product of the Wisconsin Protective Coatings Corporation of Green Bay, Wisconsin.

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 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 discoloration of the coating about 21 inches below the top center of the tank and extending around the perimeter of the tank that marked the location of the liquid-vapor interface. Black stains in the coating could be seen throughout the tank. Pitting in the Plasite 3066 coating was also observed at random locations throughout the tank with the most severely pitted areas located at the liquid-vapor interface or in the vapor space of the tank. One of the more severe areas of pitting and corrosion was located at the top inside of the AR quadrant, where areas with general corrosion and group and random pitting were observed. The baffle for the safety relief valve was heavily pitted and corroded. Other areas where deterioration of the coating was observed included two random pits in the lower half of the AL side below the liquid-vapor interface, random pitting around the bottom outlet valve, and chips in coating covering the first circumferential girth weld inboard from the A-end.

[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 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.

An area of corrosion was observed 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 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. Therefore, the Safety Board is recommending that Union inspect a representative sample of Union-built tank cars equipped with the same configuration of housing for the eduction pipe and bowl-shaped sump as UTLX 79211, and based on the results of its inspections, modify all tank cars as necessary to ensure that the eduction pipe cannot contact the sump.

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 (AAR), 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.

The misalignment between the sump and the housing for the eduction pipe in UTLX 79211 occurred at the time the tank car was constructed. The misalignment should have been visually apparent when the eduction pipe assembly was installed,

and the resulting misalignment of the eduction pipe into the sump should have been detected at the time of construction. Further, the misalignment should have been detected during the quality control inspection by Union before the tank car was released into new service.

Further, quality control inspections following the modifications in 1988 and 1989 of the eduction pipe systems in tank car UTLX 79211 and the four other tank cars should have detected, and caused to be corrected, the misalignment problem of the eduction pipe assemblies. The performance of these inspections is one aspect of an effective quality control program. Accordingly, the Board is recommending that Union evaluate and modify, as necessary, the quality assurance program for its tank car facilities to ensure that tank cars are constructed and modified or repaired in accordance with approved designs.

As the result of its investigation of the release of butadiene from a tank car in New Orleans, Louisiana, on September 8, 1987,[3] the Safety Board recommended that the FRA:

> Establish quality control requirements for tank car manufacturers and tank car repair shops sufficient to ensure that actions taken comply with Federal regulations and with any conditions established in Association of American Railroads approvals for manufacture, repair, or modification of rail tank cars. (R-88-63)
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> Require that tank car repair shops develop and maintain current written procedures to guide their employees in performing work on tank cars and that their employees be trained on those procedures. (R-88-64)

The FRA contracted with the Illinois Institute of Technology Research to develop a tank car manufacturing/repair/retest facility evaluation form and an accompanying manual to help ensure that the manufacturing and repair of tank cars are consistent with Federal and industry standards. The manual was completed in 1993 and distributed to FRA and AAR inspectors for their use in tank car facility inspections. Copies were also distributed to all tank car manufacturing and repair facilities.

In addition, in the notice of proposed rulemaking (NPRM) published under docket HM-201 on September 16, 1993, the FRA and the Research and Special Programs Administration (RSPA) proposed standards to require facilities that build, repair, or modify railroad tank cars to have quality assurance programs "...to help prevent and detect nonconformities during the manufacturing, repair, or inspection

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[3] National Transportation Safety Board. 1988. Butadiene release and fire from GATX 55996 at the CSX terminal junction interchange in New Orleans, Louisiana, September 8, 1987. Hazardous Materials/Railroad Accident Report NTSB/HZM-88/01. Washington, DC

and test process." In its comment letter dated March 17, 1994, to this NPRM, the Safety Board concurred with the proposed requirements and noted that without some oversight provisions by the FRA, the safety benefits anticipated from the quality assurance programs may not be realized. Further, the proposed rule requires that the quality assurance program must ensure that the finished product conforms to the requirements of the applicable specifications and regulations and has the means to detect any nonconformity in the manufacturing, repair, or testing of the tank car. In its letter of September 8, 1994, addressing these recommendations, the FRA indicated that the final regulations should be published in 1995. In its followup letter of December 5, 1994, the Board classified Safety Recommendations R-88-63 and -64 "Open--Acceptable Action," pending the adoption of a final rule under docket HM-201. The Safety Board looks forward to expeditious issuance of these regulations.

Although the Hickson Corporation was not involved with the evaluation or selection of the Plasite 3066 coating in UTLX 79211 (because Hickson did not assume control of the tank car until about 10 months after the coating had been applied), Hickson as the shipper of hazardous materials was responsible under the DOT hazardous materials regulations to ensure that the container, tank car UTLX 79211, was compatible with the lading with respect to several factors, including corrosivity. The investigation revealed that Hickson did not possess reliable corrosion data for the arsenic acid on carbon steel. Further, the Wisconsin Protective Coatings' technical bulletin that warned against the total and continuous immersion of the coating in chemicals with high corrosion rates should have prompted Hickson to question the suitability of the coating for arsenic acid service, to gather additional data for a more thorough evaluation of these coatings in arsenic acid service, and to assess how the immersion tests outlined in the technical bulletin related to the service environment in a railroad tank car. Rather, Hickson continued to have the phenolic Plasite coatings applied to its other tank cars without evaluating the performance of these coatings in arsenic acid service or determining an appropriate life-cycle of these coatings. Consequently, the Safety Board concludes that Hickson did not adequately evaluate the suitability of the Plasite 3066 and 3070 coatings with arsenic acid. Based on the deterioration of the coatings in tank cars UTLX 79211 and 75951, the Safety Board is concerned that the Plasite 3066 and 3070 phenolic coatings and other comparable baked phenolic coatings may not be suitable coatings for railroad tank cars in long-term arsenic acid service.

From the time Hickson assumed operational control of its leased tank cars in February 1989 to the failure of UTLX 79211, Hickson also had sufficient opportunities to monitor the condition of the coatings in its tank cars. Hickson officials stated that an employee entering the tank was to note any flaws or defects in the coating. However, tank car UTLX 79211 was inspected on June 1 prior to being loaded, and the corrosion damage in the sump area should have been observed by the person conducting the inspection, but was not. Further, the failure of a sump through corrosion in one of Hickson's tank cars in May 1993 indicates that interior inspections of tank cars in general were inadequate. Had an effective procedure been

in place to inspect the interior of tank cars and to ensure that the condition of the coatings were noted and reported and that action was taken to repair the coatings, the advanced deterioration of the coatings in UTLX 79211 and UTLX 75951 should not have occurred. Consequently, the Safety Board concludes that Hickson did not have an effective program for inspecting the interior of tank cars or for monitoring the condition of the coatings and replacing them before they reached an advanced stage of deterioration.

The existing standards in the DOT hazardous materials regulations do not address the need to perform periodic tests and inspections of tank coatings and linings. The FRA and RSPA have proposed standards under docket HM-201 that would require the owner of a lined or coated tank car transporting materials corrosive to the tank to determine the periodic inspection interval and inspection technique of the material used and to maintain all supporting documentation, such as the manufacturers' recommended inspection interval and inspection technique for linings and coatings. The Safety Board believes that the deficiencies noted in this accident regarding the selection and evaluation of coatings and the subsequent monitoring of the performance of the coatings support the need for such standards.

However, Union has indicated that while it may require a tank car to be protected with a lining or coating, the selection, evaluation, and maintenance of the coating or lining is the responsibility of the lessee (usually the party with operational control of the tank car). Further, many tank car owners, including Union, consider the lessee (tank car user) to be the owner of the lining. The FRA also considers the selection, evaluation, and maintenance of the coating or lining to be the responsibility of the shipper (typically the party with operational control of the tank car). The shipper or party with operational control of the tank car would have the most knowledge about the physical and chemical properties of cargoes and has the responsibility to evaluate and select the coating or lining to protect a tank car. Consequently, the shipper or user of the tank car should be expected to be knowledgeable about the lining or coating in the tank car and to determine the periodic inspection interval or testing technique. Although it would be beneficial for the tank car owner to have this information, the party with operational control of the tank car should determine the minimum inspection interval and testing technique for linings or coatings based upon the type of evaluation and selection process previously discussed. Therefore, the Safety Board believes that the FRA and RSPA should require that the shipper or party using a tank car to transport materials corrosive to the tank determine the periodic inspection interval and testing technique for linings and coatings, and require that this information be provided to parties responsible for the inspection and testing of tank cars.

Therefore, as a result of its investigation of this accident, the National Transportation Safety Board recommends that the Federal Railroad Administration:

> Evaluate, with the assistance of the Railway Progress Institute and the Association of American Railroads, 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 from misaligned components of the eduction pipe systems in tank cars. (Class II, Priority Action) (R-95-9)
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> Require, in cooperation with the Research and Special Programs Administration, that the shipper or party using a tank car to transport materials corrosive to the tank determine the periodic inspection interval and testing technique for linings and coatings, and require that this information be provided to parties responsible for the inspection and testing of tank cars. (Class II, Priority Action) (R-95-10)

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

Chairman HALL, Vice Chairman FRANCIS, and Member HAMMERSCHMIDT concurred in these recommendations.

By: Jim Hall
Chairman