National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 16, 2002

In reply refer to: I-02-4 and R-02-17

Honorable Christine Whitman
Administrator
U.S. Environmental Protection Agency
Ariel Rios Building, Room 3000
1200 Pennsylvania Avenue
Washington DC 20460

The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

This recommendation addresses the adequacy of Federal regulations and oversight for cargo transfer operations involving bulk containers transporting hazardous materials. The recommendation is derived from the Safety Board's investigation of the July 14, 2001, hazardous materials accident at the ATOFINA Chemicals, Inc., (ATOFINA) plant in Riverview, Michigan, and is consistent with the evidence we found and the analysis we performed. As a result of this investigation, the Safety Board has issued six safety recommendations, two of which are addressed to the Environmental Protection Agency (EPA). Information supporting this recommendation is discussed below. The Safety Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendation.

About 3:45 a.m., eastern daylight time, on July 14, 2001, at the ATOFINA plant in Riverview, Michigan, a pipe attached to a fitting on the unloading line of a railroad tank car fractured and separated, causing the release of methyl mercaptan, a poisonous and flammable gas. About 4:09 a.m., shortly after the Riverview Fire Department chief arrived on scene, the methyl mercaptan ignited, engulfing the tank car in flames and sending a fireball about 200 feet into the air. Fire damage to cargo transfer hoses on an adjacent tank car resulted in the release of chlorine, a poisonous gas that is also an oxidizer. The fire was extinguished about 9:30 a.m. Three plant employees were killed in the accident. There were several other injuries; most of the injured were treated for respiratory symptoms and released. About 2,000 residents were evacuated from their homes for about 10 hours. Two tank cars, railroad track, and plant equipment (including hoses and fittings) were damaged in the fire.[1]

[1] For more information, see National Transportation Safety Board, *Hazardous Materials Release From Railroad Tank Car With Subsequent Fire at Riverside, Michigan, July 14, 2001*. Hazardous Materials Accident Report NTSB/HZM-02/01 (Washington, D.C.: NTSB, 2002).

The Safety Board determined that the probable cause of the accident was a fractured cargo transfer pipe that resulted from (1) the failure of ATOFINA to adequately inspect and maintain its cargo transfer equipment, and (2) inadequate Federal oversight of unloading operations involving hazardous materials. Contributing to the accident was ATOFINA's reliance on a tank car excess flow valve to close in the event of a leak from cargo transfer equipment and the company's failure to require appropriate safety equipment for employees involved in tank car loading and unloading operations.

Metallurgic examination of the failed transfer pipe revealed evidence of erosion-corrosion resulting in a significant thinning of the pipe wall. The flow of the liquefied methyl mercaptan through the pipe caused a gradual erosion of the metal. The erosion was accelerated during each exposure of the interior of the pipe to the weather, when atmospheric corrosion converted small amounts of the steel to iron oxides (rust). Subsequent liquid flow during unloading eroded, or swept away, the iron oxide on the interior of the pipe, revealing clean steel that readily corroded during its next exposure to the atmosphere. The consequence of such cyclic action is the gradual wearing away of the interior surface of the pipe wall, which reduces the strength of the pipe.

During use, the failed pipe was subjected to bending forces by the attachment of an unloading apparatus that weighed about 53 pounds. The Safety Board's metallurgy staff estimated that about 175 pounds of additional downward force applied on the outer end of the apparatus would have resulted in the failure of the pipe; however, this is only an estimate, and the actual force required may have been different. The Safety Board concluded that erosion and corrosion had weakened the transfer pipe such that application of a force such as an individual's falling, leaning, or stepping on the pipe or dropping an object on it, in combination with the weight of the unloading apparatus, could have caused the pipe to break and release the methyl mercaptan.

ATOFINA's Process 46 general operating instructions specified that operators perform a visual, external inspection of transfer piping each time unloading connections were made to a methyl mercaptan tank car. However, external visual inspections would not have detected the reduction in wall thickness caused by the erosion-corrosion that led to the transfer pipe failure in this accident.

ATOFINA's mechanical integrity program included written procedures that covered the inspection and maintenance of all plant equipment used in the handling of hazardous materials, including the transfer pipes used to unload hazardous materials from tank cars. But the inspection procedures under the mechanical integrity program did not establish specific inspection cycles. Instead, the procedures set out subjective and vague inspection standards such as "often" when deterioration is "extreme" and "seldom" when deterioration is "minimal."

While ATOFINA could not provide data or records to confirm whether or when the transfer pipe that failed in this accident had last been inspected under the mechanical integrity program, the erosion-corrosion that was found within the failed pipe indicated that the program had clearly not been effective. The Safety Board concluded that ATOFINA's failure to implement effective procedures for inspection and maintenance of its unloading pipes and fittings allowed the transfer pipe in this accident to gradually deteriorate and ultimately fail.

ATOFINA's procedures at the time of this accident did not require that employees wear self-contained breathing apparatuses (SCBAs) while performing cargo transfer operations on methyl mercaptan tank cars. In fact, ATOFINA's procedure for leak testing the unloading apparatus by having the operator pressurize it with the methyl mercaptan and attempt to detect the odor of this poisonous gas actually required the operator to be unprotected to perform the test. This procedure subjected employees to the risk of injury.

Because methyl mercaptan, like chlorine gas, is toxic by inhalation, the use of approved respiratory protection equipment is appropriate to prevent inhalation exposure that could lead to incapacitation and death. An operator wearing such equipment when the release occurred would not have been incapacitated and would have had time to escape the area and/or respond successfully to the emergency. Even an escape hood with an emergency air supply that can be donned in the event of a sudden and unexpected release of poisonous gas would have provided sufficient oxygen to permit an individual to escape the area in the case of such an emergency. Therefore, the Safety Board concluded that the use of proper personal protective equipment, such as SCBAs or escape hoods, would likely have allowed the employees in this accident to survive the initial release of methyl mercaptan and either safely evacuate the area or close the unloading valve and stop the leak.

Both the EPA and the Occupational Safety and Health Administration (OSHA) required ATOFINA to develop and document safety plans for the Riverview facility that included safeguards intended to reduce the risk and consequences of catastrophic releases of hazardous materials. ATOFINA's risk management plan (mandated by the EPA) and process hazard analysis (mandated by OSHA) included an accident scenario that involved the failure of a flexible hose on the unloading apparatus for a methyl mercaptan tank car—a scenario similar to this accident. Under both plans, ATOFINA indicated that the release of methyl mercaptan would be stopped by the automatic closure of the tank car's excess flow valve. Further, ATOFINA's risk management plans explicitly noted that excess flow valves on the tank car would activate in the event of a pipeline or unloading hose rupture. However, when the transfer pipe failed on July 14, 2001, the excess flow valve on the tank car did not close and stop the release of the methyl mercaptan.

Calculations made by Safety Board engineers and parties to the investigation indicated that the flow rate of methyl mercaptan through the broken transfer piping was insufficient to cause the excess flow valve to close. Excess flow valves are designed to close and stop the release of product from the tank car in the event a tank car valve or fitting is broken or sheared off during transit. Attaching cargo transfer apparatus to a tank car can change product release rates and flow rate characteristics and can prevent the excess flow valve from closing in the event of an emergency. As noted by the Chlorine Institute in its *Chlorine Manual* and by the Safety Board in its investigation of a July 30, 1983, accident at the Formosa Plastics plant in Baton Rouge, Louisiana,[2] tank car excess flow valves are not designed to act as an emergency shutoff device during cargo transfer.[3]

To determine whether reliance upon tank car excess flow valves as safety mechanisms during transfer operations is restricted to ATOFINA or is a broader problem, Safety Board investigators interviewed a sampling of domestic chemical companies. Interviews with personnel responsible for company safety plans revealed that six of nine companies surveyed rely on tank car excess flow valves as a method of stopping or limiting a leak in the transfer equipment. Only one company reported having remotely operated shutoff valves on the unloading piping just outside the tank car dome. (The other two companies did not respond to the Safety Board's inquiry.) Although the Safety Board's sampling was limited, the results suggest that the inappropriate use of tank car excess flow valves may be a widespread practice in the chemical industry.

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[2] National Transportation Safety Board, *Vinyl Chloride Monomer Release From a Railroad Tank Car and Fire, Formosa Plastics Corporation Plant, Baton Rouge, Louisiana, July 30, 1983*, Hazardous Material Accident Report NTSB/HZM-85/08 (Washington, D.C.: NTSB, 1985).

[3] Although excess flow valves are routinely used as safety mechanisms in the piping systems of fixed facilities, those excess flow valves are designed and constructed for specific piping systems and the properties of the material flowing through the pipe.

To address this issue, the Safety Board believes that the EPA should notify all facilities that are required to submit risk management plans to the EPA that tank car excess flow valves cannot be relied upon to stop leaks that occur during tank car loading and unloading operations and that those companies that have included reliance on such valves in their risk management plans should instead identify and implement other measures that will stop the uncontrolled release of product in the event of a transfer line failure during tank car loading or unloading.

As alluded to earlier, several Federal agencies, including Department of Transportation (DOT) modal agencies, the EPA, and OSHA, provide safety oversight for elements of hazardous material bulk container loading and unloading operations. None of these programs provided the level of oversight necessary to prevent the Riverview accident.

The EPA and OSHA each have multiple program responsibilities mandated by several statutes. Under the authority of the Clean Air Act and the Occupational Safety and Health Act, the EPA and OSHA exercise some oversight at chemical plants, which includes oversight of hazardous materials transfer operations involving tank cars, highway cargo tanks, and other bulk containers. However, oversight of hazardous materials cargo transfers is only a minor element of these agencies' chemical plant oversight programs, which are themselves elements of still larger programs.

Also, the number of inspectors each agency has assigned to oversee these operations is limited compared to the number of chemical facilities and plants that fall under the agencies' respective programs. The EPA estimates that its risk management program regulates at least 15,000 facilities within the United States; about 2,800 facilities are in Region V, which covers a five-State area that includes Michigan. The EPA had only three inspectors to oversee its risk management program in Region V, and those personnel had conducted only three inspections between the inception of the program in 1999 and the 2001 Riverview accident.

Because of the scope of its oversight responsibilities, OSHA delegates some of those responsibilities to State agencies. MIOSHA, the Michigan agency that has been delegated to provide OSHA oversight within the State, has only two chemical plant inspectors for the entire State. Since 1993, MIOSHA inspectors have conducted approximately 85 plant inspections. Thus, after more than 8 years, the agency has not been able to inspect all of the 100 facilities that, because of the quantities and types of chemicals they use, were identified in the 1993 OSHA oversight program plan as the highest priority plants.

The inspections that EPA and OSHA inspectors must conduct are complicated and intensive because, according to Federal requirements, each EPA or OSHA inspector is expected to oversee all plant operations for each of the regulated facilities. With a chemical plant the size of ATOFINA, this could mean inspecting more than a dozen processes, each with numerous procedures and employees, and hundreds of pieces of equipment. Each piece of equipment may be subject to as many as 12 different safety requirements. For example, the 1994 MIOSHA audit of the ATOFINA Riverview plant took approximately 960 hours to conduct, yet it covered only 2 of the 14 processes at the facility in depth. In addition, although 35 violations were noted during the audit (including ATOFINA's failure to implement a mechanical integrity program for its plant piping system), MIOSHA conducted no follow-up inspection to ensure that ATOFINA had corrected the cited violations.

The EPA and OSHA oversight programs have additional weaknesses. For instance, although the EPA and OSHA both require each facility to develop a written plan that describes the procedures and mechanisms in place under each safety program, neither agency routinely evaluates the plans to determine the effectiveness or appropriateness of the procedures and mechanisms. Also, other than such reviews as take place during the rare plant inspections, neither agency verifies that the plants comply with the standards identified in their own plans.

The Federal Railroad Administration (FRA) has 50 inspectors to determine compliance with the hazardous materials regulations. Although the single FRA inspector responsible for the State of Michigan has approximately 90 facilities to oversee, he generally has been able to inspect all of those facilities annually. In fact, the FRA has inspected the Riverview plant seven times in the past 6 years. The FRA inspectors are able to perform more frequent inspections than either the EPA or OSHA because, at least in part, FRA inspections focus on the limited requirements relating to tank car loading and unloading that are contained in the hazardous materials regulations. These regulations cover the setting of tank car brakes, the chocking of wheels, the placing of caution signs on the track, and attendance during unloading operations. They do not address the inspection, maintenance, and support of cargo transfer fittings; the development of safe unloading procedures, including leak test procedures for fittings; or the use of personal protection equipment by the operators unloading the tank car.

The Safety Board therefore concluded that effective oversight of hazardous materials loading and unloading operations from tank cars and other bulk containers is not provided by the FRA, the EPA, or OSHA.

As a result of its investigation of the Riverview accident, the National Transportation Safety Board therefore makes the following safety recommendations to the Environmental Protection Agency:

> Assist the U.S. Department of Transportation in developing safety requirements that apply to the loading and unloading of railroad tank cars, highway cargo tanks, and other bulk containers that address personal protection requirements, emergency shutdown measures, and the inspection and maintenance of cargo transfer equipment. (I-02-4)
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> Notify all facilities that are required to submit risk management plans to the Environmental Protection Agency that tank car excess flow valves cannot be relied upon to stop leaks that occur during tank car loading and unloading operations and that those companies that have included reliance on such valves in their risk management plans should instead identify and implement other measures that will stop the uncontrolled release of product in the event of a transfer line failure during tank car loading or unloading. (R-02-17)

The Safety Board also issued safety recommendations to the U.S. Department of Transportation, the Federal Railroad Administration, and the Occupational Safety and Health Administration. In your response to the safety recommendations in this letter, please refer to Safety Recommendations I-02-4 and R-02-17. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

Original Signed

By: Marion C. Blakey
Chairman