

NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.

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Forwarded to:

Admiral John B. Hayes  
Commandant  
U.S. Coast Guard  
Washington, D. C. 20593

SAFETY RECOMMENDATION(S)

M-81-93 and -94

About 1340 on May 31, 1981, the U.S. tankship MONTICELLO VICTORY, which was in an idle status with a small maintenance crew onboard and moored at an isolated berth in the Port Arthur, Texas, area, exploded and burned. The vessel had no cargo onboard, but it was not gas-free. No tank cleaning was done, and there was no survey of the vessel by a marine chemist. Although not required, such a survey is frequently conducted when a tankship is expected to be out of service for an extended period. At the time of the explosion, welding was being conducted in the engineroom on the auxiliary bilge discharge line which extended up to a valve on the main deck. A path for flame propagation from the welding operation was found to exist since the valve was found open, with a hose attached. A nearby Butterworth port to a cargo tank was open and without flame-screen protection. There were no deaths or serious injuries, but damage to the after cargo tanks and superstructure was estimated at \$20 million. <sup>1/</sup>

Since there had been no lightning in the vicinity of the ship for about 3 hours, since everybody onboard was accounted for at the time of the explosion, and since all cargo tanks had taken on air through the individual tank vents as cargo was discharged, the Safety Board concluded that neither lightning, conscious acts by crew personnel, nor pyrophoric iron sulfide deposits caused the explosion.

The investigation revealed two mechanisms whereby the auxiliary bilge discharge system could have been filled by a gas-air mixture entering the system via the hose, while the hose was in the cargo tank or lying near the open Butterworth port.

First, the engineroom bilges were pumped into the No. 11 center cargo tank about 9 days before the accident. When the bilge pump was stopped, the bilge water in the pipeline could have drained back through the pump into the bilges. As the water column descended in the pipeline, a gas-air mixture would have been siphoned from tank No. 11 center into the hose and into the auxiliary bilge line, possibly through the bilge pump and other bilge piping. If valves were not closed for some time, the water column flowing back into the bilge may have been sufficient to cover

<sup>1/</sup> For more information read "Marine Accident Report—Explosion and Fire Onboard the U.S. Tankship MONTICELLO VICTORY, at Port Arthur, Texas, May 31, 1981" (NTSB-MAR-81-14).

the bilge suction, forming a water seal, which could prevent vapor in the bilge piping from flowing out into the bilges. Thus, most of the bilge system could have contained a gas-air mixture from the last time the engineroom bilges were pumped into the cargo tank until the time of the explosion.

Secondly, a gas-air mixture from the open Butterworth port could have entered the hose sometime after the pumpman cut the hole in the auxiliary bilge line with the acetylene torch. The threaded pipe connection, which had been partially arc welded into the hole in the pipe, was examined on a number of occasions during the investigation. The area around the pipe which remained to be welded at the time of the explosion was estimated to total about one-half square inch. During each examination, a flow of air was detected coming out of this opening. This airflow was attributed to a slight pressure differential between the engineroom and the outside, possibly caused by warm air rising in the engineering space and passing upward through grates around the flue inside of the shell of the exhaust stack or by a draft up through the gates induced by airflow over the after deckhouse.

Calculations indicate that the flow velocity of the air, or gas-air mixture, through the 2 1/2-inch pipeline could have ranged from 10 to 16 feet per second after the hole was cut in the pipe. A flow velocity inside the pipe of this magnitude may have existed for nearly 2 hours from sometime before 1130, when the pumpman went to lunch, until about 1315 when he began to weld the threaded pipe nipple into the auxiliary bilge line. At these flow rates, the pipeline could have been filled in a few seconds. Thus, the line could have been filled with a flammable gas-air mixture anytime up to immediately before the explosion.

Testimony indicates that the welding operation had been in progress for 15 to 25 minutes when the explosion occurred. Flame passage through the pipe from the welding site could have been prevented during the burning and welding by either overrich or overlean zones in the pipe or by flow velocities down the auxiliary bilge pipeline into the engineroom which were high enough to prevent flame propagation against the flow. Flame could have passed through the line to the vicinity of the open Butterworth port when the highly variable concentration of gas in the line fell in the flammable range, or it could have occurred when the flow velocity decreased as the opening in the pipe was progressively closed off during the welding operation.

Therefore, the Safety Board believes that a flammable gas-air mixture was drawn into the auxiliary bilge discharge system probably by one of the means discussed above, that it was ignited by the welding being conducted in the lower boilerroom, and that the flame propagated through the auxiliary bilge discharge line and the attached hose to the vicinity of the open Butterworth port of No. 11 center cargo tank. Vapors venting from the opening were ignited and the flame propagated into the tank, causing the explosion.

The Safety Board believes that the Coast Guard's guidelines for the layup of foreign flag tank vessels contained in the Marine Safety Manual (CG-495) contribute substantially to the safety of U.S. ports and waterways, and that similar guidelines should be extended to U.S. tank vessels. Such guidelines would insure that standard procedures are followed in all United States ports. If similar guidelines had existed, the inspection by a certified marine chemist--as required for foreign tankships--would have resulted in the issuance of a marine chemist's certificate setting forth qualifications and requirements for performing hot work. This inspection would have provided the ship's crew with the information about the hazards of performing hot work on a nongas-free vessel and specifically the vessel's bilge system. A marine chemist would be aware of the potential danger and would recognize the possible routes of flame propagation. A single additional safety precaution stemming from awareness of the potential hazard, such as securing the Butterworth opening, would have prevented this accident.

The fact that hot work in the engineering spaces can lead to an explosion in the cargo tanks is cause for concern and requires increased awareness on the part of tankship crews. Apparently, concern for the environment which has made it necessary to alter some engineroom bilge systems so that they can connect to the cargo tanks may have reduced certain environmental harm while creating unsafe conditions onboard tankships. It is no longer safe to employ burning or welding indiscriminately to repair engineroom bilge pipelines on those tankships capable of transferring bilge water into heretofore isolated cargo tanks. Engineering personnel must first determine that no path for flame propagation exists between engineroom bilge systems and a cargo tank before conducting any such hot work.

The practice of using cargo tanks for bilge water also necessitates positive coordination between the deck and engineering departments. To insure that efforts of the two departments are well coordinated, standard procedures and safety precautions clearly delineating responsibility should be developed for each vessel and promulgated in writing. A well-established and well-documented procedure for pumping engineroom bilges to a cargo tank probably would have prevented the Butterworth port's being opened and remaining open for more than 1 week without supervision by the deck department, and probably would have prevented this accident. The Safety Board believes that the lack of established procedures onboard the MONTICELLO VICTORY for pumping engineroom bilge water to a cargo tank led to confusion and complacency about responsibility for maintaining the gas-tight integrity of the cargo tanks.

There are no regulations addressing the proper means of introducing bilge water into a cargo tank. Leading a hose into the tank may result in bilge water falling all the way to the bottom, possibly creating static electricity in the tank. Also, an open Butterworth port results in some degree of hazard if the tank is not gas-free, whether it is supervised or not. Therefore, the Safety Board believes that this matter deserves further study by the Coast Guard.

Access to gangways and brows on tankships usually requires travel along the main deck. This may not be possible in case of an emergency, as was the case for personnel in the after deckhouse of the MONTICELLO VICTORY. It was fortuitous that the chief engineer was able to find quickly a length of suitable line for escape over the stern of the vessel and that the CLAMP was so close by with a small boat.

A recommendation, issued by the Safety Board as a result of its investigation of an accident at an oil terminal on the Delaware River on April 9, 1974,<sup>2/</sup> and later reiterated following investigation of the SEATIGER accident <sup>3/</sup> asked that the U.S. Coast Guard:

Study the positioning of shipborne gangways and shore-placed brows to determine ways to provide for rapid personnel escape from vessels during emergencies. (M-78-39)

The Coast Guard has not acted on Recommendation M-78-39. The Safety Board believes that the positioning of gangways is critical to the rapid escape of ship crews during an emergency and, therefore, reiterates this recommendation and urges the Coast Guard to take the recommended action as soon as practical.

<sup>2/</sup> "Marine Accident Report—M/T ELIAS, Explosion and Fire at the Atlantic Richfield Company Fort Mifflin Terminal, Delaware River, Pennsylvania, April 9, 1974" (NTSB-MAR-78-4).

<sup>3/</sup> "Marine Accident Report—Liberian Tank Vessel M/V SEATIGER, Explosion and Fire, Sun Oil Terminal, Nederland, Texas, April 19, 1979" (NTSB-MAR-80-12).

As a further result of its investigation of this accident, the National Transportation Safety Board recommends that the U.S. Coast Guard:

Develop and promulgate guidelines for U.S. flag tankships entering an idle or layup status similar to the guidelines contained in the Marine Safety Manual (CG-495) for layup of foreign flag vessels. (Class II, Priority Action) (M-81-93)

Review the approved plans of those U.S. flag tankships that have been modified to permit the retention of engineroom bilge water in cargo tanks and investigate the procedures employed by such ships to determine if any unsafe practices are involved, particularly in the manner in which the temporary hose is connected to a nongas-free cargo tank, and promulgate safe guidelines as may be required. (Class II, Priority Action) (M-81-94)

KING, Chairman, DRIVER, Vice Chairman, and GOLDMAN and BURSLEY, Members, concurred in these recommendations. McADAMS, Member, did not participate.

  
By: James B. King  
Chairman