



# National Transportation Safety Board

Washington, D. C. 20594

## Safety Recommendation

352  
Long M-21731

Date: July 7, 1989

In reply refer to: M-89-33 through -35

Mr. Joseph H. McCabe, III  
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About 2215 on August 31, 1988, an explosion in cargo tank 1 of the 711-foot-long Maltese tank vessel FIONA killed one person and blew off the top of the cargo tank. The vessel, which was moored about 2 miles offshore near the Long Island Lighting Company (LILCO) power plant at Northport, New York, was preparing to discharge about 41,000 long tons of No. 6 fuel oil, a Grade E cargo, into the LILCO subsea pipeline. Damage costs were estimated to be \$500,000.<sup>1</sup>

As a result of its investigation, the Safety Board found that some Grade E cargoes can produce explosive vapors in vessel cargo tanks, and there is a need for vessel crews to determine whether cargo tanks contain explosive vapors before sampling or measuring cargoes. The FIONA was equipped with an operational combustible gas detecting device. It would have taken only a few minutes to determine whether the FIONA cargo tanks contained explosive vapors. Had the FIONA crew tested the cargo tanks, they would have found that all the tanks contained explosive vapors. The FIONA master could then have activated the inert gas system, vented the tanks, or taken other precautions which probably would have prevented the explosion in cargo tank 1.

For some time before the explosion, steam had leaked in the space above the liquid in the cargo tank 1. It is a well documented fact that steam leaks in cargo tanks will generate a considerable amount of static electricity that resides in the steam cloud. The introduction of an ungrounded metal object into such a steam cloud can result in charge accumulation and then a discharge of sufficient energy to ignite an explosive petroleum vapor mixture when the metal object is brought near a grounded surface.

<sup>1</sup> For more detailed information, read Marine Accident Report--Explosion Aboard the Maltese Tank Vessel FIONA in Long Island Sound Near Northport, New York, August 31, 1988 (NTSB/MAR-89/03).

Although the surveyor using the stainless steel temperature probe stated that he had laid the temperature probe on the tank 1 hatch cover before he saw flames shooting out of the ullage opening, probably the probe touched the metal edge of the ullage opening as it was being withdrawn and static electricity discharged. A discharge of static electricity near the top of the ullage opening is consistent with other witness testimony. Such a discharge would ignite the hydrocarbon vapors at the top of the tank and the flame would then propagate down into the tank with a subsequent explosion. Witnesses first saw a "yellow light" near the tank opening followed by flames, a rumbling noise in the tank, and an explosion. The hydrocarbon mixture at the ullage opening ignited. This flame then followed the hydrocarbon vapors back into the tank and an explosion occurred.

The laboratory analysis of the recovered pieces of electrically insulated cable from the temperature probe were inconclusive as to whether arcing from the temperature probe had ignited the vapors. Although a scanning electron microscope analysis of the probe cable showed an area where the tin coating on the copper wire had eroded away, most likely by arcing, and iron particles had been deposited in the area, it was not clear if this arcing had triggered the explosion or had occurred at some previous date. The Safety Board believes that the explosion in cargo tank 1 was triggered by a static electrical charge generated by the steam leak which accumulated on the temperature probe and discharged as the temperature probe was being withdrawn from the tank.

The Safety Board examined the temperature probe to determine whether grounding the probe would have prevented the accident. Based on the probe's electrical circuitry, the Safety Board determined that had the temperature probe been properly grounded to the deck while the SGS Control Services (SGS) surveyor measured the temperature of cargo tank 1, any static electricity picked up by the probe from the steam leak would have been discharged through the ground connection. Thus, any charge accumulation on the probe would have been discharged to the cargo tank and ignition of the explosive vapors probably would not have occurred. However, when the Suffolk County Police Department opened the control box of the temperature probe after the explosion, the nuts holding the ground wire to the external connection for the ground wire had come off and the internal ground connection was loose. The Safety Board could not determine when the internal grounding wire for the temperature probe control box became loose. However, if the internal grounding wire had been loose at the time the SGS surveyor was measuring the temperature of cargo in tank 1, attaching the external ground would not have prevented the electrostatic discharge which ignited the explosive vapors in cargo tank 1.

American Petroleum Institute (API) standards for determining the temperature of a petroleum cargo using a portable temperature probe state that the portable temperature probe should be grounded before opening the ullage hatch cover. The API safety precaution does not make any exceptions regarding the flammability of the cargo. The SGS surveyor measuring the temperature of the cargo in tank 1 at the time of the explosion stated that he did not ground the portable temperature probe that he was using because he was measuring No. 6 fuel oil which he did not consider flammable and that this was in accord with API procedures. The Safety Board believes that the SGS surveyor had not been properly trained at SGS in API procedures and the explosion probably would have been prevented if the cargo surveyor had grounded the temperature probe according to API safety standards, assuming the internal temperature probe grounding wire was properly connected.

The temperature probe was fitted with a nameplate which had no information regarding grounding procedures. According to the manufacturer, ERGON, grounding procedures had not been printed on the nameplates of the temperature probes sold before 1987 because Underwriters Laboratories, Inc. (UL) had never required them. The temperature probe used by the SGS surveyor was sold in 1986. When ERGON wanted to sell its temperature probe in 1987 in Canada, the Canadian Standards Association required that information be added to the nameplates stating that the temperature probe must be grounded before and during introduction into a cargo tank and remain grounded until after complete withdrawal. Had the temperature probe used by the SGS surveyor contained the grounding instructions shown on temperature probes sold after 1987, he may have grounded the probe. The Safety Board believes that both SGS and E.W. Saybolt, Inc. should inspect the internal ground connection of their temperature probes and instruct their surveyors to ground portable temperature probes no matter what grade of petroleum product is being measured.

Therefore, as a result of its investigation, the National Transportation Safety Board recommends that E.W. Saybolt, Inc., and SGS Control Services:

- . Require surveyors to have the atmosphere in cargo tanks carrying Grade E cargoes tested and certified nonexplosive before sampling, or measuring the tank contents. (Class II, Priority Action) (M-89-33)

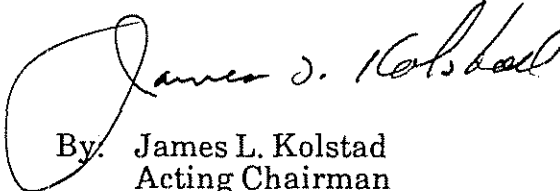
Require surveyors to ground their temperature probes while measuring Grade E cargoes. (Class II, Priority Action) (M-89-34)

Inspect periodically the internal ground connections of temperature probes to ensure that the internal ground connection is securely connected. (Class II, Priority Action) (M-89-35)

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 action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations M-89-33 through -35 in your reply.

Also, the Safety Board issued Safety Recommendations M-89-12 through -21 to the U.S. Coast Guard; M-89-22 and -23 to the American Petroleum Institute; M-89-24 through -26 to the International Chamber of Shipping; M-89-27 through -32 to the Bedford Ship Management; M-89-36 and -37 to ERGON, Inc.; and M-89-38 to Underwriters Laboratories, Inc.

KOLSTAD, Acting Chairman, and BURNETT, LAUBER, NALL, and DICKINSON, Members, concurred in these recommendations.

  
By: James L. Kolstad  
Acting Chairman