PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of the initial explosion was (1) the presence of explosive gasoline vapors in the forward deckhouse, where ignition sources were permitted, and (2) the existence of a trail of vapor from the deckhouse back to the gases within the No. 1 center tank. The source of ignition for the second explosion could not be determined from the evidence. However, the continued blowing of air into the tank replaced the oxygen consumed in the first explosion and probably made the second explosion possible. Contributing to the accident were:

1. The failure to maintain a fume-tight boundary between the crew quarters and the gasoline vapors exhausted from the No. 1 center tank.

2. The uncontrolled discharge of voluminous explosive vapors in the deck area, and the lack of flame screens on the tank discharge to prevent gases accidentally ignited outside of the tank from reaching the contents of the tank.

3. The absence of specific procedures for cleaning cargo tanks which contained gasoline residue.

4. The inability of the tank-venting supervisor and crew to recognize the hazardous situation that had developed.

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RECOMMENDATIONS

The National Transportation Safety Board concurs in recommendations 1 through 4 of the Coast Guard Marine Board of Investigation and further recommends that the U. S. Coast Guard:

1. Require that safety meetings be held on tankships to instruct supervisors and crewmembers in the specific procedures used to wash and gas-free cargo tanks on the particular tankship. (Recommendation No. M-74- 20)

2. Conduct a special inspection on the VENUS and similar tank vessels operating on the Great Lakes to make certain that adequate procedures concerning the

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prevention of entry of inflammable vapors into the deckhouses which were revealed in this investigation have been corrected. (Recommendation No. M-74-21)

3. Require that all hazardous gases forced out of cargo tanks during gas-freeing operations shall be ducted to the safest areas available, preferably over the downwind side of the ship. In addition, a flame screen should be required in the duct or at the tank opening. (Recommendation No. M-74-22)

4. With the assistance of industry, develop methods to gas-free cargo tanks by suction processes which remove the vapors from the densest regions of the tank. (Recommendation No. M-74-23)

5. Evaluate the need for all future installations of normal cargo vent piping to contain an individual flame screen for each tank, in lieu of permitting a flame screen from a header to serve several tanks. (Recommendation No. M-74-24)