



FINDINGS OF CONCERN

Office of Investigations and Casualty Analysis

February 26, 2024
Washington, DC

Findings of Concern 002-24

STOWAGE PLANS, LOADING, AND STABILITY

Purpose. The U.S. Coast Guard issues findings of concern to disseminate information related to unsafe conditions that were identified as causal factors in a casualty and could contribute to future incidents. Findings of concern are intended to educate the public, state, or local agencies about the conditions discovered so they may address the findings with an appropriate voluntary action or highlight existing applicable company policies or state/local regulations.

The Incident. In the early morning hours, a roll-on/roll-off (RO-RO) vessel departed port loaded with 4,200 vehicles. While underway in the channel, the Pilot ordered the vessel to turn to starboard. As the vessel began the turn, it unexpectedly heeled to port. The rudder and propeller came out of the water, and the vessel became non-responsive to helm commands. The vessel began to take on water through an open pilot door and experienced downflooding almost immediately. As the flooding progressed, the vessel continued to heel further to port and capsized within minutes of the initial flooding. Crewmembers became trapped in the engine room of the vessel and other areas by the ingress of water.

Contributing Factors and Analysis. As a result of its investigation, the U.S. Coast Guard determined that the vessel did not meet the mandatory Severe Wind and Rolling criteria (Part A, Section 2.3) of the International Maritime Organization (IMO) Intact Stability Code (2008).

The company and vessel did not have a detailed written process for developing the stowage plan and calculating stability included under their Safety Management System. The unofficial process for developing the stowage plan included the use of a third-party cargo planner to generate the pre-stowage plan based on the average vehicle weights. The Chief Officer used the pre-stowage plan to calculate the stability of the vessel with a computer stability program, which calculated the metacentric height (GM) and overall stability of the vessel. Following the incident, the Chief Officer noted that he calculated the stability using the previously mentioned computer stability program after loading operations were completed and received an acceptable stability condition prior to departure. There was no secondary review of the Chief Officer's inputs into the computer system or of the final stability results indicating an acceptable stability condition. Of note, the pre-loading calculated GM was 1.96 meters and the post-loading GM was 2.45 meters, despite the addition of vehicles on three of the vessel's upper decks, approximately 17 metric tons of fuel consumption, and no additional ballast.

During the investigation the Coast Guard completed an analysis of the cargo stowage plan and the liquid load quantities reported by the vessel's integrated monitoring, alarm, and control system (IMACS) at the time of the incident. This analysis found that the actual GM when the vessel departed port was 1.76 meters, 31% less than the GM calculated by the Chief Officer prior to the incident. The Coast Guard calculated GM would have resulted in a stability situation that was not in compliance with the vessel's Trim and Stability Booklet; therefore, the vessel was not in compliance with the



UNITED STATES COAST GUARD
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stability requirements of the IMO Intact Stability Code (2008) and was in an unacceptable overall stability condition. Additionally, the Coast Guard re-entered the loading conditions of the vessel at the time of the incident into the computer stability program on a similar vessel and received a “NOT OK” result by the system.

Findings of Concern. The Coast Guard has identified the following measure that owners and operators of RO-RO vessels can take to mitigate this risk:

- Incorporate written procedures for developing stowage plans and calculating vessel stability into the vessel’s safety management system. Those procedures should include an independent verification of the stability calculations against the Trim and Stability Booklet. This independent verification should incorporate trained crew or shoreside personnel to validate the Chief Officer’s calculations prior to the vessel’s departure from port. This would assist in identifying potential errors in stability and loading calculations, including erroneous inputs and/or outputs from the vessel’s computer stability program.

Closing. These findings of concern are provided for informational purpose only and do not relieve any domestic or international safety, operational, or material requirements. For any questions or comments please contact the Office of Investigations and Casualty Analysis (CG-INV) by email at HQS-SMB-CG-INV@uscg.mil.