Developments in Maritime Transportation and Exploitation of Sea Resources – Guedes Soares & López Peña (eds)
© 2014 Taylor & Francis Group, London, ISBN 978-1-138-00124-4

Stability problems arising from fire-fighting measures for Ro-Ro ship: Simulation model and possible actions to improve the drainage system

M. Acanfora & T. Coppola
Dipartimento di Ingegneria Industriale, Sezione Navale, Università degli Studi di Napoli "Federico II", Naples, Italy

ABSTRACT: This paper deals with the stability problems arising from fire-fighting measures, for the ro-ro ship. Recent accidents involving several ferries, have underlined the need for a more accurate analysis of the transient stage of the fire-fighting operations in the car deck compartment. The fire safety for a ro-ro ferry is strictly linked to the stability: the deluged water, if not correctly drained, could lead to the heeling or even to the capsizing, due to the high free-surface moment arising. The prediction of the time for losing stability and possible actions to avoid this phenomenon become an important aspect for vessel safety. A six-degree of freedom model for the ship dynamics has been developed, in order to estimate the effective floating condition at each time. For the applications, a typical ro-ro passenger ferry has been chosen. The vessel behavior has been analyzed for different efficiency rates of the drainage system.

1 INTRODUCTION

Ro-ro ships are vessels designed to transport cars and other wheeled vehicles. The main safety problem for these ships is represented by the risk of fire in the ship garage. This compartment extends over the greatest possible length, located near the operating waterline.

Differently from a traditional vessel, the ro-ro ship may not have any kind of separation to prevent a whole level from filling up with water or for a fire to spread throughout a large area.

Several accidents involving ferries brought out the need for an improvement in the fire safety and protection, aiming a revision of the reference rule for the fixed fire extinguishing systems on ro-ro decks (IMO 1967).

Different works, such as (Frid and Palm 2010) and (Arvidson 2010), deal with new sprinkler installation guidelines for ro-ro deck. They approached the problem focusing only on the deluge systems, assessing the requirement of a higher water discharge.

The fire safety for a ro-ro ferry is strictly linked to the stability; the deluged water, if not correctly drained, could lead to the heeling or even to the capsizing, due to the high free-surface moment arising.

The Al Salam Boccaccio 98 disaster was caused even by the poor efficiency of the drainage system during the fire-fighting actions; the Vincenzo Florio fire accident was leading the ship to capsize for the obstruction of the scuppers by the goods carried in the trucks on the ro-ro garage.

The main aim of this paper is to bring to the attention to the need of a proper car deck drainage system in conjunction with an efficient fire-fighting system.

Nowadays IMO is giving updated guidelines in designing and maintaining the drainage system. However no additional stability criteria taking into account the confined water on the ro-ro deck from fire-fighting measures are provided yet. The effects of water ingress for the ro-ro ships, regarding the damage stability, have been already faced by several works (Santos and Guedes Soares 2006), (Vredeveldt and Journe 1991), (Vermeer et al., 1994), (Acanfora et al., 2011) and (Santos et al., 2002) and addressed and acknowledged by the rules in the Stockholm Agreement criteria; the problem of the added water from fire protection, instead, is mentioned by the rules, but without giving any specific guideline. In the following section an overview of the actual regulation regarding the water-spraying fire extinguishing and drainage systems in the garage of ro-ro passenger vessels has been reported.

In this work a model for the ship dynamics has been developed in order to evaluate at each time the effective GM of the ship during the transient stage of the fire-fighting operations in the car deck compartment. A simplified model regarding the forces and the moments induced by the water on deck has been developed (Jankowski and Laskowski 2006) and implemented in the simulation. The ship behavior has been analyzed assuming different efficiency rates of the drainage system. Several applications have been performed on a ro-ro passenger