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Safety of Occupants in Freefall Lifeboats - Injury criteria and limits

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ABSTRACT

The IMO safety criteria for lifeboats, the CDRR or CAR procedure, are both addressing the injury risk to occupants based on seat panel accelerations, thus related to the overall body acceleration. However, based on full scale drop tests with an automotive crashdummy (ATD) it was concluded that additional criteria for head and neck are required as tolerance levels for automotive injury criteria were exceeded. Given the loading scenarios expected in lifeboats, being vertical, frontal, rear and side impact loading to the occupant, the most promising set of injury criteria are the upper neck loading parameters (Fx shear force, Fz axial force and flexion-extension moment My) and two combined neck criteria being Nij and Nkm. For the head the widely used HIC criterion was adopted. It is recommended that regionally specific occupant injury assessment criteria obtained through the use of an ATD during testing, such as the ones proposed in this paper, be adapted in future evaluation of occupant safety in freefall lifeboats. The use of an ATD includes the effect of restraints and the occupants' attire which is fully omitted by the existing IMO procedure.

INTRODUCTION

The Norwegian Oil Industry Association's LifeBoatProject (OLF LBP) has been running from 2005. Structural response and acceleration induced loads to occupants are analyzed by model-, fullscale- and numerical studies of up to sixteen different types of freefall lifeboats. The number of hardware tests adds up to over 13000 tank model tests, over 200 full-scale lifeboat drops and over 30 inverse sled tests with an instrumented crash-test dummy. In addition, FE analysis and numerical simulations have been applied for a more in depth evaluation of the boats' performances.

Injury criteria and tolerances are an important basis for evaluating occupant safety by estimating the injury risk caused by acceleration induced loads. Up until now one has used the criteria given in the International Maritime Organization (IMO) Testing and Evaluation of LSA (Life Saving Appliances)

code [IMO, 1992] - i.e. the CAR or CDRR procedures. However, both these procedures have shortcomings:

- “(...) neither method can predict if any injury will occur nor what that injury will be. Rather, the criteria merely provide an indication of the potential for an injury to occur” [IMO, 1992b]
- “Neither method can explicitly evaluate the effects of occupant-seat coupling. Such an evaluation can only be performed with a human surrogate” [IMO, 1992b]
- Using acceleration time-series from freefall lifeboats, research in the OLF LBP shows that the CAR procedure always give a higher result compared with CDRR (i.e. CAR is more conservative). The difference between