COMPOSITE PANELS LOADED BY CLOSE-IN CHARGES ON THE WATER SURFACE

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Close-in blast resistance of maritime composite structures was unknown, particularly for submersed charges on the water surface. The hull of a mine clearing vessel is typically made from composite and the threat of quite small charges detonating close to the hull is not unlikely given the nature of their operation. The last decade we studied only failure behavior of typical ship steel structures due to small charges at close range. Therefore, we initiated an experimental series to investigate composite hull behavior due to close-in blast from small explosives at the water surface.
Three hull designs of a composite naval ship were selected. A solid laminate, which could be used as an affordable solution hull if weight and speed of the vessel is less important. A longitudinal head stiffened hull and a sandwich hull are the two light weight alternatives. Their areal mass is approximately equal and one third of the solid laminate, however, the production complexity is large compared to the solid laminate.
We designed a test set-up with a small pond in our bunker facility. AUTODYN simulations were performed to determine the effect of reflections given a relatively small container of water. The stand-off and charge mass were chosen to be of the same order of range and size as we knew from the close-in failure of steel hull panels. The experiments showed that the solid laminate suffered minor damage. The sandwich and hat stiffened hull designs showed damage but no full breach. In both cases these hull concept showed more damage above the waterline than below the water line.