OPTIMISATION OF NUMERICAL MODELLING FOR STRUCTURES SUBJECTED TO INTERNAL BLAST

M. Saleh[1,3], V. Pickerd[2,3], G. Yiannakopoulos[2,3], M. Brincat[2,3], P. Vincent[2,3], L. Bortolan Neto[1,3], Z. Mathys[2,3], W. Reid[2,3]

[1]Australian Nuclear Science and Technology Organisation, Locked Bag 2001, Kirrawee DC, NSW 2232, Australia; [2]Defence Science & Technology Group, 506 Lorimer St, Fishermans Bend, Melbourne, VIC 3207, Australia; [3]Defence Materials Technology Centre, Level 2, 24 Wakefield St., Hawthorn, VIC 3122, Australia

Key words : vulnerability assessment - high strain rate - blast loading – numerical modelling

The design of modern military and naval platforms is often assisted by experiments and computational simulations, that provide relevant insights about material reliability, mechanical performance and design vulnerability to blast loading. An important design consideration for naval platforms is the damage response of structures from internal blast loading which is characterized by high strain rate loading and complex shock and blast wave interactions and reflections. To understand the damage response of structures under this loading condition, scaled experiments coupled with numerical simulations are used to identify (a) the temporal displacement fields using *in-situ* DIC measurements (b) onset of critical failure in various elements and (c) spatial distribution of internal pressure fields.

A methodology for understanding the failure response of structures to internal blast loading is investigated using both scaled experiments and numerical modelling. Experimental data, including pressure, displacement, plastic strain and acceleration measurements, are compared with simulation results to determine modelling accuracy for both elastic and plastic deformation. The multi-scale modelling approach adopts a discretization technique for the structure by way of variations in the material property attributes of: weld material, Heat Affected Zone (HAZ) and parent material. The blast propagation and fluid structure interaction are achieved through an ALE simulation framework and provided insights into the deformation mechanisms exhibited in stiffened containers. Multiple structure configurations are simulated to explore this design space and results are compared with the experimentally observed loading and structural response behaviours. The simulation results, alongside the scaled experiments, provide a robust framework for the prediction of blast response of representative naval structures and allows for their optimization to improve both the subsystem and platform integrity.