STORAGE TANK RESPONSE TO LARGE-SCALE BLAST: NUMERICAL ANALYSIS, EXPERIMENTAL TESTING AND VALIDATION

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Key words: Blast, Storage Tank, FEA, Hydrocode, modelling

Abstract:

To predict the consequences of large-scale explosions, it is desirable to understand the response of various industrial and civil structures to blast loading. In the absence of full-scale trials on such structures, and with limited data available in the literature in this regard, emphasis is often placed on modelling to investigate problems of this type. In order for confidence to be placed in analysis results, it is therefore important that adequate validation is performed. A recent investigation into the response of storage tanks employed an approach whereby experiments undertaken at scale were used to validate full-scale simulations.

The numerical study was undertaken to investigate the sensitivity of response of storage tanks to the following factors: geometry, fill level and loading. Tank geometries were based on typical standards of design and variations in overall diameter and panel thicknesses were considered. Three tank fill levels were investigated: full, half full and empty, and a range of stand-off and charge height combinations were assessed. Several key damage mechanisms were identified, influenced primarily by fill level.

In support of this study, a series of scaled tests was conducted. These tests were used to confirm the damage mechanisms identified from the modelling and provide quantitative validation data. Various diagnostics were fielded to capture the nature of the loading and the response of the tanks. The data collected was subsequently used for comparison with equivalent results from numerical simulations of the physical tests undertaken prior to the trial to aid trial design.

The previously identified damage mechanisms were replicated in the tests, and good agreement was demonstrated between numerical and physical results.

An outline of the initial numerical study, a description of the experimental programme and an overview of the subsequent validation exercise will be presented and discussed. Emphasis will be placed on the numerical approaches considered and the relative benefits and limitations of each.