A REVISED ANALYSIS OF THE BEIRUT EXPLOSION

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Key words: blast source model, blast profile generator, TNT equivalence

Abstract: The circumstances of the Beirut explosion of 4 August 2020 led to an unprecedented scale of impromptu video coverage of the event made by casual observers which was then made available on social media and newscasts. Several researchers have estimated the effective yield of the explosion by technical analyses of these video/audio records and correlating results to a 'TNT equivalency', e.g, [1]. However, approximating the Beirut explosion as a scaled version of a standardized ground-burst hemispherical charge with a particular TNT equivalence leads to confusing results as observed by Dewey [2] and potential misinterpretation of the actual explosive reaction. It is known for example that the approximately 2750-ton stockpile of ammonium nitrate was configured in a broad layout of stacked bin-bags of approximately 2-3m total height.

The PVCG blast-source model [3,4] is a simplified computational method to simulate the mid- and far-field blast conditions from arbitrary explosive events including non-ideal or ill-defined reactive processes as expected in the case of the Beirut blast. The current simplified CFD study uses the PVCG explosion source model to demonstrate that key phenomena observed from the event, including the remarkable condensation cloud and unusual overpressure decay with distance, and are best explained by some manner of constant-volume explosion of the ammonium nitrate considered as a massive flat charge. Supplemental analysis to track the shock and condensation fronts as taken from a particular video sequence shows very good correlation with this model.

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