COMBUSTION WEBINAR

Mechanisms and Occurrence of Detonations in Vapor Cloud Explosions

Speaker: Dr. Elaine S. Oran, Texas A&M

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Meeting: *Zoom*

Registration (required): Check https://sun.ae.gatech.edu/combustion-webinar/ for details or directly contact wenting.sun@aerospace.gatech.edu.

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Biography

Dr. Elaine S. Oran is TEES Eminent Professor in the Department of Aerospace Engineering at Texas A&M University. Previously she was the A. James Clark Distinguished Professor and the Glenn L. Martin Institute Professor at the University of Maryland. For many years before that, she was the Senior Scientist for Reactive Flow Physics at the US Naval Research. She received an A.B. from Bryn Mawr College and a Ph.D. from Yale University. She is a Member of the National Academy of Engineering, an Honorary Fellow of the AIAA, and a Fellow of the American Academy of Arts and Sciences, the CI, AIAA, ASME, and SIAM. Her recent research interests include chemically and nuclear reactive flows, numerical analysis, high-performance computing, shocks and shock interactions, and rarefied gases, with applications to combustion, propulsion, and all sorts of explosions ranging in scale from micro-dynamical to astrophysical.

Abstract

Not all accidental releases of flammable gases and vapors create explosions. Most releases do not find an ignition source, and of those that do ignite, most of them result in deflagrations that generate low or moderate overpressures. Under some circumstances, however, it is possible for deflagration-to-detonation transition (DDT) to occur, and this can be followed by a propagating detonation that quickly consumes the remaining detonable cloud. In a detonable cloud, a detonation creates the worst accident that can happen. Because detonation overpressures are much higher than those in a deflagration and continue through the entire cloud, the damage from a DDT event is more severe.

This presentation first provides a basic summary of our knowledge to date of the fundamental mechanisms of flame acceleration and DDT. This information is then contrasted to and combined with evidence of detonations (detonation markers) obtained from large-scale tests and actual large vapor cloud explosions (VCEs). The explosions considered include those at Buncefield (UK), Jaipur (India), CAPECO (Puerto Rico), and Port Hudson (US), and Brenham (US, Texas). The major conclusion is that detonations did occur in a significant number of VCEs. Finally, actions are suggested that could be taken to minimize detonation hazards.