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Explosive System Hazards, Munitions Vulnerability, Unintended Ignition, 3 days 4 instructors

OVERALL OBJECTIVES:

The range of parameter space to which explosive materials and munition systems may be exposed, as a result of accidents or hostile attack, in terms of thermal, mechanical and electrical stimuli is immense. Participants in this course will understand the great differences between responses of explosives to unintended stimuli versus use of explosives in a designed manner. Participants will learn of experimental methods, analytical approaches and case studies that may help them to devise active and passive ways to reduce the likelihood of violent response of conventional and insensitive munitions under hazardous environments. From a systems hazards viewpoint, the subject matter covers familiar topics such as shock initiation and less familiar topics such as cookoff, deflagration-to-detonation transition (DDT), ignition by shear loading, and the effect of confinement in nurturing an ignition reaction to become violent.

LEARNING OBJECTIVES:

At course completion each student should understand certain fundamental response behaviors and be able to recognize conditions that may promote or may mitigate the vigor of response of an explosive system that has been exposed to hazard stimuli. A student should be able to do the following things.

1. List factors that influence the behavior of explosive in a cased munition exposed to projectile impact, both in shock-initiation response and crushing-impact response.
2. Identify conditions of projectile shape and contact angle under which the explosive within a munition is most vulnerable.
3. Recognize conditions in which it is appropriate to employ the modified Jacobs-Roslund model, the James model or the Pop plot to analyze the response of cased explosive under shock loading.
4. Describe the phenomena that govern response of a bare or cased explosive to shaped-charge jet attack.
5. Explain the main differences between the Semenov and Frank-Kamenetskii models for thermal explosion.
6. Distinguish differences responses due to slow and fast cookoff environments and describe the effects of confinement upon violence of the responses.
7. List three or more principal factors that promote deflagration-to-detonation transition (DDT).

8. Identify one or more design or intervention techniques that might reduce the probability of DDT in a cased munition.
9. Describe differences in what governs the response between test conditions appropriate for laboratory safety screening and for the response of a cased munition subjected to a) high-voltage electrical breakdown through the energetic material and b) crushing impact against a hard surface.
10. Become familiar with DOD and STANAG tests concerning insensitive munitions.

IMMEDIATE BENEFITS:

Each student who completes this class will be familiar with the physics and chemistry that control the outcome of insensitive munitions tests and with the vulnerability of munitions to heating at various rates, projectile impact at a range of velocities, or high-power electrical discharge. The student will be aware of approaches that might be used to model or assess real systems hazards situations, both experimentally and analytically. He/she will also be familiar with DOD Insensitive Munitions Policy and the tests used in Insensitive Munitions Evaluations.

INSTRUCTORS:

Instructors for this course will be Dr. James Kennedy of HERE, LLC, Dr. Blaine Asay of Los Alamos National Laboratory (LANL), Dr. Robert Frey (U.S. Army, retired), and Dr. Jimmie Oxley (URI & HERE). Dr. Kennedy has over 45 years experience in explosives work, with 32 years at Sandia and Los Alamos. This includes large-scale field work on crushing-impact hazards to nuclear weapons, analysis of explosive performance, gas-gun experiments, development of detonators and small-scale tests. Dr. Asay has performed DDT experiments and led a long-term project at LANL to understand the response of explosives under cookoff environments, with emphasis on chemical kinetics, the effect of porosity due to thermal damage developed within the explosive before ignition, and the output of rapid deflagration. Dr. Oxley has 20 years of experience in energetic materials safety, performance and detection. She is presently professor of Chemistry at University of Rhode Island and co-Director of the DHS Center of Excellence in Explosives-Detection, Mitigation, Response. Dr. Frey had a distinguished Army career with ARL at Aberdeen. He has been involved with R&D activities involving explosives and armor for nearly 40 years, including analysis of the response of explosives under shear loading and due to jet penetration.