Hazards of Electromagnetic Radiation to Ordnance

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Definition

The HERO discipline balances the requirements for the electromagnetic environment (EME) of the spectrum user and the susceptibility of electrically initiated ordnance while performing its intended mission throughout its operational life cycle to determine if safety or reliability issues exist. Consequently, HERO occurs when transmitting equipment (e.g., radios, radars, electronic countermeasures, ground penetrating radars) or other electromagnetic-radiating devices generate radiation of sufficient magnitude to induce or otherwise couple electromagnetic energy and inadvertently causes the actuation (or dudding) of electrically initiated ordnance. As a result, the affected ordnance cannot function as intended or an immediate catastrophic event can occur that destroys equipment or injures personnel. An electrically initiated device (EID) is a single unit, device, or subassembly that uses electrical energy to produce an explosive, pyrotechnic, thermal, or mechanical output. Examples include electro-explosive devices such as hot bridgewire, semiconductor bridge, carbon bridge, conductive composition laser initiators, exploding foil initiators, burn wires, and fusible links, all of which have different response characteristics. For HERO, the EME is defined as the totality of electro-magnetic energy—both intentional and unintentional radiation—to which platform/system or subsystem/ equipment will be exposed within the land, air, space, and sea domain, while performing its intended mission from the time it leaves the manufacturer to the time of its disposal (commonly referred as the stockpile-to-safe preparation sequence). In short, HERO is the incompatibility between the EME and electrically initiated ordnance.

History

As early as the 1940s, a number of unexplained accidents involving electrically initiated ordnance were suspected to have been directly related to stray radio frequency (RF) emissions. In the 1950s, RF energy caused the initiation of a Mk 6 Mod 13 torpedo exploder mechanism. Around this time, a number of other aircraft carrier HERO incidents were also documented. Consequently, in 1956, the Chief, Bureau of Ordnance initiated a formal HERO Program at the Naval Surface Warfare Center, Dahlgren Division (NSWCDD), then known as the Naval Proving Ground (NPG), Dahlgren. The development of the HERO Program was primarily one of organization, both philosophically and practically.

In 1994, during Operation Restore Democracy, Army and Air Force helicopters, brought Army and Air Force ordnance aboard a Navy carrier. These weapons were neither designed nor evaluated to the Navy shipboard electromagnetic environment, resulting in significant restriction of the ship's emitters. This restriction resulted in impeding the effective use of the carrier's radar and communication systems. This also reinforced the need for a DoD-wide policy to address variations in the testing and certification of ordnance.

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Policy

The Department of Defense Explosives Safety Board recognized the importance of mitigating HERO in explosives safety. As such, it has published HERO requirements in the DoD 6055.09-M, Volume 2. It states that the acquisition managers shall evaluate and certify the weapons systems in all of the stockpile-to-safe separation sequences. This means that the weapon systems exposed to the electromagnetic environments specified in MIL-STD-464 will not be adversely affected by that environment. If the weapon system passes, it will be certified as HERO SAFE ORDNANCE. If it does not pass, but must be deployed, then it will be deployed to the warfighter with restrictions required to safely handle the ordnance and be documented. The results of these tests shall also be compiled in a centralized data repository to support the Joint Spectrum Center's Ordnance Electromagnetic Environmental Effects Risk Assessment Database (JOERAD).

The DoD Manual also states that the Services take measures (e.g., identifying susceptibilities, quantifying EMEs, evaluating risks associated with operation procedures, and establishing tailored emission control instructions) to ensure that HERO effects are resolved. This requirement is further flowed to the Department of the Army in DA PAM 385-64, Ammunition and Explosives Safety Standards. This provides policy on determining safe separation distances from radio frequency sources to ordnance and ordnance operations.

What Now?

To satisfy all these requirements, you will need certain information about the ordnance and transmitters. The emitter information should be easy to obtain by going to your local spectrum manager. Obtaining the ordnance information may present greater difficulty. The policy requires that the Services have a central database where this information is retained. However, this policy is relatively new and all the Services have not yet set up the databases to collect this data.

Joint Spectrum Center Electromagnetic Environmental Effects Risk Assessment Database (JOERAD)

Fortunately, the Joint Spectrum Center (JSC) is developing a tool that will assist in these calculations. The guidance for the development of this tool comes from the Joint Ordnance Commanders Group HERO Subgroup. The primary goal of JOERAD is to provide operational commanders and planners with the necessary information to safely and efficiently manage the conflict between ordnance and radio frequency emitters employed in an integrated joint operation or exercise. This tool gathers ordnance data from the Services, including the maximum allowable environment (MAE) the ordnance can be exposed to without the potential for premature initiation and the transmitting equipment characteristics from the JSC Equipment, Tactical, and Space (JETS) database. Unit/Platforms are built that contain the ordnance loadout and list of transmitting equipment used by each unit/platform. The Impact Analysis will compare the electromagnetic environment generated by the source platform with the susceptibility of the ordnance on the victim platform. If the EME generated is greater than the MAE of the ordnance, JOERAD will provide guidance in the form of safe separation distances or transmitter power management.

Once the data from the services have been fully populated, JOERAD will be a single source of ordnance HERO data and will provide a unified calculation methodology, thus greatly reducing the inconsistencies in guidance that is produced today.

For further information, you can contact the JOERAD Help Desk at JoeradHelp@disa.mil.