



Radio Frequency Radiation: High Power Microwave Devices (e.g., Jackal, Calilgo, etc.) - Leaders

FACT SHEET 24-010-1011

Introduction: Many technologies are used to defeat improvised explosive devices (IEDs). High-power microwave (HPM) systems such as the Jackal, Calilgo, etc., use one of these technologies. These systems use radio frequency (RF) radiation and are typically installed on MRAPs, MATV's, HMMWV's, etc. They use directional antennas mounted on the vehicle bumpers to radiate energy in front of and away from the vehicle.

What is Nonionizing or Radio Frequency Radiation (RFR)? People often think of radioactivity when they hear the term "radiation". Not all radiation is the same or has the same effects on the human body. There are two types of radiation: ionizing and nonionizing. Scientists categorize radio frequency (sometimes referred to as microwave), infrared, and visible light radiation as being in the "nonionizing" radiation part of the electromagnetic spectrum. At these frequencies, there is not sufficient energy to cause "ionization" of atoms or molecules as occurs at higher frequencies such as X-rays or gamma rays. As such, "nonionizing radiation" does not cause genetic damage or cell mutation and is not cumulative, i.e., there are no lasting effects. Radio frequency radiating systems such as the Jackal and Calilgo are examples of devices that generate nonionizing radiation.

Are there Biological Health Effects from Radio Frequency Radiation? Yes. There can be heating effects from high levels of RF radiation, much like in a microwave oven. Thermal (heating) effects are the primary health risk from exposure to RF radiation. RF radiation at high levels can cause heating of biological tissues (such as the body) and cause an increase in body temperature. Microwave oven cooking relies on this principle. If our bodies absorb too much RF energy and we are not able to dissipate the heat, our body temperature could rise. The body's response to high RF exposure is similar to that from other thermal (heat) stressors whether from a sauna, hot bath, hot climates, etc. Once a person leaves a high energy RF field or any high temperature environment, the body returns to normal temperature.

Low level RF radiation exposure levels that do not produce detectable heating have also been a concern in research studies. These effects are often referred to as "non-thermal" effects as there is no detectable temperature increase. Decades of research has shown that there are no long-term or short-term health effects from low-level RFR exposures. Low level RF exposures are not cumulative like X-rays and have not been shown to be carcinogenic (cancer causing).

Are there Radio Frequency Radiation Exposure Standards for Personnel? Yes. RFR exposure standards have been developed by National and International standards organizations that protect individuals from RF radiation that causes significant body temperature increase. These standards incorporate a ten-fold safety factor with regards to heating levels known to cause observable temperature rise. DOD has adopted these standards. All DOD RF radiating sources require evaluation for potential RF hazards prior to use to ensure personnel are not exposed to RFR levels that exceed the standards. The Jackal, Calilgo, and other IED defeat technologies have been evaluated in this manner.

Where are the RF Radiation Areas of Concern for HPM systems (Jackal, Calilgo, etc.)? The area in front of the vehicle where the antenna is mounted is the primary concern due to the antenna's high RF radiation levels. HPM systems such as the Jackal, Calilgo, etc., use directional antennas, meaning the RF radiation is in the desired direction. The antennas are designed to radiate with a wide azimuth beam but short elevation (vertical) beam ensuring the RF radiation is not directed in vehicle areas occupied by personnel. RF radiation levels in the cab, in back and sides of the vehicles have been measured to be tens of times lower than DOD standards.

What Safety Procedures Should Be Observed for HPM Systems? Some soldiers are often concerned about RF radiation exposure from sources such as the JACKAL, CALILGO, etc. Personnel must observe the recommended "stand-off" distances from the antenna(s), which is forward of the vehicle bumper. This distance is specified in the technical manuals, SOP's, etc, and only applies when the antenna is radiating.

How Do I Know If I've Been Overexposed to RF Radiation? Adverse health effects to users of HPM systems such as the Jackal, Calilgo, etc., are not expected unless exposure results from prolonged time in front of the radiating antenna (within the stand-off distance). RF radiation from the front of the antenna could cause localized damage to tissues or heat stress. Symptoms typically are a warming sensation and/or reddening of the skin. The sensation of warmth alone is not an indication of an RFR "overexposure" as "overexposure" also takes into consideration the time duration of exposure and what part of the body has been exposed. As always, if someone is sick, he/she should seek medical care to identify and treat any specific conditions that may be responsible for the symptoms. RFR overexposure is rare.

What Should I Do If I Think I've Been Overexposed to RF Radiation? Contact your radiation safety officer or designated unit safety POC if you suspect you have been "overexposed" to RF radiation levels exceeding the standards. Otherwise contact your medical treatment facility. Safety procedures should be in effect for your specific RF system but incidents can occur due to equipment failure and/or human error. By alerting your safety contacts and medical providers of possible overexposures, you can prevent RFR overexposure to others.

What Is the Treatment for Overexposure to RF Radiation? Medical Attention for overexposure to RFR depends on the exposure level, the duration of exposure, and the part of the body that was exposed to RF Radiation. For exposures to RFR that exceed the DOD maximum permissible exposure (MPE), you should receive an appropriate medical exam. The incident should be investigated and documented. Eye examination is only required if the exposure is greater than 5 times the MPE.

References

IEEE C95.1-2005, *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*, 19 April 2006.

DODI 6055.11, *Protecting Personnel from Electromagnetic Fields*, 19 August 2009.