Electronic Warfare: The use of electromagnetism by the military

Abstract

With the introduction of gun-powder and bullets, human warfare entered a new level of violence and suffering that people could succumb to. With the introduction of technology, human warfare entered a new level of strategy with the use of radar and telecommunication systems to gain advantages over their enemies.

As we entered the second half of the 20th century, the progression of technology allowed for great advancement in warfare, so much so that we see the introduction of electromagnetism to immobilise and also harm the enemy.

In this report I will discuss the use of electromagnetism in modern warfare, namely High Altitude Electromagnetic Pulses (HEMPs).

Early Electromagnetic weaponry

The first real consideration of using electromagnetism was in the Cold War. The thinking was that by firing an atom bomb into the atmosphere, the radio-frequency energy released when the bomb exploded would induce a sudden surge of electricity in the enemies' electrical machines which would cause them to stop functioning[1].

In 1962, The United States military conducted a test in which they had a controlled explosion of a nuclear bomb over the Pacific Ocean. The HEMPs from the blast spanned so far that they disrupted electrical communications devices in Hawaii, 800 miles away. From this test (Code-named: Starfish Prime), they concluded that an explosion such as this over Kansas would pretty much wipe out all electrical devices in the United States.[2]

Causes of HEMPs

When a nuclear bomb explodes high above the earth, HEMPs are produced. The release of gamma-radiation into the atmosphere combines with the particles in the air, which releases a great amount of electrical energy into the atmosphere in the form of electrons which have been disassociated from the outer shells of atoms in the air, ie. The Compton Effect.[2] This electrical energy release causes the vast EMPs as it combines with the earth's magnetic field.

The power of an EMP is based on three factors namely:

1. Rise Time: How long it takes the pulse to reach peak amplitude.
2. Field strength: Defines the amount of energy available to transfer to the target system.
3. Frequency: Determines the efficiency of that transfer[3].

"EMPs are typified by fast rise times, high field strengths, and broad frequency content"[3]

Effects of HEMPs

As afore mentioned, the nuclear test off the pacific coast was a very good example of what can happen when these HEMPs are created.

Electrical devices made to receive electromagnetic signals with components such as antennae are the most vulnerable to EMPs, however other electronic devices are not altogether safe either. The EMPs can enter a device through trailing wires, cracks or conduits. High voltages and currents are

induced by the EMPs. These aspects of the EMPs attack the smaller wires in the circuitboards and cause them to melt. Not only wires may be affected though. Due to the 10kV/s that can be induced, the main electrical components in circuitry can be permanently destroyed, destroying communications systems, military systems, flight controls and much more, which could cripple a nation.[3]

Present-Day EMP weaponry

The Chinese have, in their efforts to regain control over Taiwan, created EMP weapons that could disable all American weaponry in Taiwan at any time according to a report in 'The Washington Times' published on 11th July 2011.[4]

The Russians are said to also have made advancements in their 'super-EMP' weapon since 2004. This intel has leaked into North Korea since then and in 2009 North Korea tested their 'super-EMP' weapon which caused an emission of gamma rays powerful enough to knock out the entire United States power grid (25megatons).[5]

Protection against EMPs

If there is to be this much EMP –based attacks surely there will need to be protection for the electronic devices under such attack. Faraday cages provide such protection. It works on the basis that as you approach the faraday cage with an external electrical charge, the neutral particles in the metal of the cage will separate into positive and negative particles. The negative particles then attract the positive particles of the approaching electrical charge and vice versa, hence neutralising the effect of the external charge and producing an electric field of zero inside the faraday cage, conserving the internal components.[6]

This phenomenon is not new, however it has not been utilised appropriately by the military before now. They have two options; Store their main control systems in bunkers built as faraday cages, or incorporate minute faraday cages in each electrical device. Both options are quite expensive with the former being the most plausible as there is already EMP resistant concrete and re-constructing every piece of electronic machinery with faraday cages included would be too expensive.

Conclusion

It seems that High Altitude Electromagnetic pulses are the main use of electromagnetism in modern warfare where militaries seem to be aiming to disable their enemies before attacking them the conventional way. It is interesting to see how warfare continues to develop in such a way that we are heading toward cyber battles rather than conventional ones. It seems that Faraday cages are going to be a big centre-point for military development in the future to prevent the destruction of key devices and by extension many innocent lives.

References:

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