Dawn of the E-Bomb: High-Power Microwave technology and Military implications for India

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Introduction:

An article titled ‘Dawn of the E-Bomb’ by Michael Abrams in the Nov 2003 issue of the IEEE Spectrum magazine starts off thus: “In these media-fueled times, when war is a television spectacle and wiping out large number of civilians is generally frowned upon, the perfect weapon would literally stop an enemy in his tracks, yet harm neither hide nor hair. Such a weapon might shut down communication networks, disrupt power supplies, and fry an adversary’s countless computers and electronic gadgets, yet still leave buildings, bridges and highways intact.”

Such a weapon is no longer in the realm of the fertile imagination of creative science fiction authors as they have not only been developed, but also tested against an adversary (some say twice) by the United States. High Power Microwaves, as they are called, (also termed radio frequency weapons) have been under investigation for several decades (since the 1940s according to some analysts) now for potential...
application as weapons for a variety of combat, sabotage and terrorist purposes. Rapid advances in the last 20 years in plasma physics, energy storage and fast switching devices have made HPMs effective and the technology is migrating outside classified government research and development laboratories.

As A E Pevler points out, since the technology is relatively new and few (even in the US) had worked on it until the demise of the Soviet Union, the societal ramification of HPM have received little analysis. In this paper, a brief introduction of the HPM technology is given followed by an explanation of the interest shown in it by different parties (both state and non-state actors) and its implications for India’s national security.

**Description of HPM technology:**

HPM technology relies on the fact that while most types of matter are transparent to microwaves, metallic conductors (as present in Metal-Oxide semiconductors) absorb them and get heated up. HPM weapons generate a very short, intense energy pulse producing a transient surge of thousands of volts that melts the circuitry and destroys the semiconductor devices. Cascading several flux compression generators in series provides the gigawatts of power needed to feed the microwave source. HPMs also produce ‘standing waves’ in electrical grid and telephone wiring. (The effects of the HPM explosions can be obscured by continuous jamming, use of stealthy aircraft like the F-117 and destruction of the opponent’s electrical grid). They can enter through cables, antennas or even ventilation grills. Further the high frequency permits parasitic capacitances to couple energy via paths in the circuit that may not be protected against over voltage.

Col Eileen Walling mentions four points of difference between HPMs and other conventional electronic warfare methods. Firstly, HPMs do not rely on the exact knowledge of the enemy system. Secondly, the HPMs have lasting and persisting effects on the adversary. Thirdly, the HPMs affect the enemy systems even when they are turned off. And finally, the opponent is now forced to harden the whole system and not just individual circuits and chips.

Analysts suggest two means of prevention against these E-bombs namely the preemptive destruction of the platform or the delivery vehicle (where the E-bomb resides) and use of modern Faraday caging techniques.

**Technological challenges:**

The United States defense establishment has concentrated research on the following areas.

1. Compact, high power Ultra-Wideband sources notwithstanding voltage standoff of the switches and fabrication issues.
2. Compact, high power Narrowband sources notwithstanding cathode breakdown, and plasma production inside the device.
3. Compact, high power, high gain UWB antennas
4. Compact, highly efficient, high power pulse power drivers
5. Explosively driven pulsed power sources taking care of coupling and timing requirements of multiple staged generators.
6. HPM effects and lethality: including RF testing of military assets, and incorporation of HPM into present engagement models.
7. Low –impact hardening against hostile and self induced EM Interference

**Why the Military wants it?**

There are several compelling reasons for militarizing the HPM technology that has induced several countries around the world to invest in it. Firstly it enables a speed-of-light, all weather attack of enemy electronic systems. (Remember that microwaves are unaffected by fog, cloud or even torrential rain). Secondly, it allows the military commander to effect a surgical strike at selected levels of combat. (Remember that HPMs are D5 class weapons incorporating Defend, Deny, Disrupt, Damage and Destroy.) Thirdly, in a politically sensitive environment it is preferable to use weapons causing collateral damage. (Remember that HPMs do not damage human beings nor do they affect bridges or buildings in any manner.) Fourthly HPMs have deep magazines, low operating costs and allow simplified pointing and tracking.

**Why a terrorist would love it?**

HPMs can be employed both in lethal and non-lethal manners by terrorists. One example of non-lethal employment would be to jam the electronics of cars in high-speed chases. As of now, the effects of a successful HPM attack remain unpredictable. The primary purpose served by the HPM is the disruption of the victim system and this would certainly allure the information age terrorist. Since no evidence remains to incriminate the perpetrator, it provides an opportunity to the terrorist groups to wreak tremendous havoc without the fear of identification or recrimination-in other words, it would enable them to commit the ‘perfect crime’. The fact that no human being is killed or injured would be exploited to the hilt in blurring the distinction between an insurgent and a terrorist. A E Pevler mentions that a Virtual Cathode Oscillator can easily be packaged into a guided missile or a free fall bomb. Such explosively driven HPM devices (the explosion would be apparent, but the EM emissions would be still be difficult to detect) would have lateral bandwidth of several hundred meters. Also the cost of assembling such a system is estimated to less than $2000.

In 1995, Islamic subversives in Chechnya used HPM to defeat a Russian security system and gain access to a controlled area.

**Implications for India:**

The biggest danger from these HPMs continues to be for the United States itself; a fact that is well recognized by its military analysts. In the Asian scenario, Japan by virtue of its small size and China by virtue of its over reliance on its Pacific rim are more susceptible to damage than India. However as a preventive measure against jihadi terrorists incubated in Pakistani madrassas, it is necessary to harden all critical systems against microwave attacks. (Similar hardening is currently done against nuclear attacks). Future systems should be hardened in
the design phase itself, as it is relatively inexpensive to do so rather than at a later stage.

With the advent of technology, the future is getting more and more insecure with ensuing encouragement to combatant groups engaged in asymmetric warfare. One ineluctable conclusion is the decisive victory of the side with better EE and CS research accomplishments in any future war. From the tone of the US analysts, the author surmises that either HPM research in India is either in its infancy or non-existent. The DRDO top brass must look into this as a matter of utmost urgency.

References:

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