

Active Denial System

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The **Active Denial System** (ADS) is a non-lethal, directed-energy weapon system under development by the U.S. military. It is a strong millimeter-wave transmitter used for crowd control (the "goodbye effect"^[1]). Informally, the weapon is also called **pain ray**.^[2] Raytheon is currently marketing a reduced range version of this technology.^[3]

The military expects deployment of the weapon to Iraq by the end of 2008.^[4]

Operation

The ADS works by directing electromagnetic radiation at a frequency of 95 GHz^[5] toward the subjects. The waves excite water molecules in the epidermis to around 55 °C (130 degrees Fahrenheit), causing an intensely painful burning sensation. While not actually burning the skin, the burning sensation is similar to that of a light bulb being pressed against the skin.^[5] The focused beam can be directed at targets at a range of just under half a kilometer, or 500 yards^[6]. The device can penetrate thick clothing, although not walls^[6]. There is no indication on the feasibility of electromagnetically shielding a person from its effects with a wire mesh or Faraday cage, in a similar manner that a microwave oven prevents radiation escaping. As the beam excites the water molecules in the skin, water bearing materials such as wet clothing/towels, wet pastes/gels, vegetables or meat could effectively absorb the energy, although the military claims that wearing wet clothing actually intensifies the effect.

At 95 GHz, the frequency is much higher than the 2.45 GHz of a microwave oven. This frequency was chosen because due to the stronger absorption of water at those frequencies, they penetrate the skin to a depth of less than 1/64 of an inch (0.4 mm),^[7] which is where the nerve endings are located. A spokesman for the Air Force Research Laboratory described his experience as a test subject for the system: "For the first millisecond, it just felt like the skin was warming up. Then it got warmer and warmer and you felt like it was on fire.... As soon as you're away from that beam your skin returns to normal and there is no pain."

The ADS is currently only a vehicle mounted weapon, however, U.S. Marines and police are both working on portable versions.

A fully operational and mounted system was demonstrated Wednesday, January 24, 2007, at Moody Air Force Base, Georgia. A Reuters correspondent who volunteered to be shot with the beam during the demonstration described it as "similar to a blast from a very hot oven - too painful to bear without diving for cover."^[8]

Controversy



Closeup of the ADS projection mechanism.

The effects of this radio frequency on humans have been studied by the military for years, and much, but not all, of the research has been published openly in peer reviewed journals. A listing of many of these articles can be found on the military Joint Non-Lethal Weapons Program website on the ADS page.

Controversy as to the methodology of testing, in which volunteers were asked to remove glasses, contact lenses and metallic objects that could cause hot spots, has raised concerns as to whether the device would remain true to its purpose of non-lethal temporary incapacitation if used in the field where safety precautions would not be taken. Proponents of the system claim that these tests were early in the program and part of a thorough and methodical process to demonstrate the safety and effectiveness of the technology, which has now involved more

than 600 volunteer subjects and some 10,200 exposures. As safety was demonstrated in each step of the process, restrictions were removed and now, according to ADS proponents, there are no restrictions or precautions necessary for volunteers



Humvee with ADS mounted.

experiencing the effect.^[9]

Critics cite that although the stated intent of the ADS is to be a non-lethal device designed to temporarily incapacitate, easy modifications or incorrect use by the operator could turn the ADS into a torture device that would violate international conventions on warfare.

Silent Guardian

The defense contractor, Raytheon, has developed a smaller version of the ADS, named the Silent Guardian. This stripped down model is primarily marketed for use by law enforcement agencies, the military and other security providers. The system is operated and aimed with a joystick and aiming screen. The device can be used for targets up to 550 m away.^[5]

Michael Hanlon - who volunteered to experience its effects - described it as "a bit like touching a red-hot wire, but there is no heat, only the sensation of heat". Contrary to Raytheon's claims that the pain ceases instantly upon removal of the ray, Hanlon said that the finger he subjected "was tingling hours later".^[10]

Contracts

22 September 2004 Raytheon was granted an FCC license to demonstrate the technology to "law enforcement, military and security organizations."^[11]

On October 4, 2004 the DoD published the following contract information:

Communications and Power Industries (CPI), Palto Alto [sic], Calif., is being awarded a \$6,377,762 costs-reimbursement, cost-plus fixed-price contract. The contractor shall design, build, test, and delivery a two to 2.5 megawatt, high efficiency, continuous wave (CW) 95 gigahertz millimeter wave source system. The contractor shall perform extensive modeling, simulation, experiments, and testing to the maximum capabilities of their facilities (which shall no less than one megawatt peak RF output) that will ascertain the final CW capabilities of the source. The contractor also shall provide input for the requirements for the government's test stand, which will serve as a full power facility in the future. At this time, \$900,000 of the funds has been obliged. This work will be complete by January 2009. Negotiations were completed September 2004. The Air Force Research Laboratory, Kirtland Air Force Base, New Mexico, is the contracting activity (FA9451-04-C-0298).^[12]

See also

- Heat Ray
- Directed-energy weapons
- Radiation
- Long range acoustic device
- Area denial weapons, to prevent an adversary from occupying or traversing an area

References

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3. ^ Raytheon: Silent Guardian product brief (http://www.raytheon.com/products/silent_guardian) (2006).
4. ^ Non-Lethal Weapon Emits Invisible Rays of Pain (<http://www.npr.org/templates/story/story.php?storyId=15739254>)
5. ^ ^a ^b ^c Hambling, David (2006), "Techwatch-Forecasting Pain", *Popular Mechanics* **183** (12): 32, ISSN 0032-4558
6. ^ ^a ^b US unveils 'heat gun' (<http://www.telegraph.co.uk/news/main.jhtml?xml=/news/2007/01/25/wuranium125.xml>) . Daily Telegraph (January 25, 2007). Retrieved on 25 January, 2007.
7. ^ Active Denial System Factsheet (<https://www.jnlwp.com/Resources/FactSheets/ADSFactSheetFinalMarch2007.pdf>) . Joint non-lethal weapons program, 2007.
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A prototype ADS being tested.

August, 2006.

10. ^ "Run away the ray-gun is coming : We test US army's new secret weapon", *The Daily Mail* (http://www.dailymail.co.uk/pages/live/articles/technology/technology.html?in_article_id=482560&in_page_id=1965)
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External sites

Non-military sites

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- Hambling, David (December 5 2006). "New Weapon, Human Tests". *Wired News*. - Contains links to test documents.
- Regan, Michael P. (August 16 2004). "Weapons evolve as wars stay with us Guns that use lasers and radio frequency to incapacitate could reduce fatalities, but critics worry about the potential for misuse". *Associated Press*.
- Sweetman, Bill (25 August 2006). "High-power microwave weapons - full power ahead?". *Jane's Defence Weekly*.
- (February 3 2005) "New non-lethal weapon lets troops dispel hostile crowds". *World Tribune*.
- (September 22 2004) "Active Denial System: A Nonlethal 'Counter-Personnel Energy Weapon'". *Why-war*. "On Sept. 22, 2004, Thomas J. Fagan, an employee at Raytheon, was granted an FCC license"
- Vehicle-Mounted Active Denial System (V-MADS) (<http://www.globalsecurity.org/military/systems/ground/v-mads.htm>) . *GlobalSecurity.org*. Retrieved on 2007-10-05.
"Countermeasures against the weapon could be quite straightforward — for example covering up the body with thick clothes or carrying a metallic sheet — or even a trash can lid — as a shield or reflector. Also unclear is how the active-denial technology would work in rainy, foggy or sea-spray conditions where the beam's energy could be absorbed by water in the atmosphere."
- Pain Ray Going Airborne (<http://www.defensetech.org/archives/001219.html>) . *Defense Tech*. Retrieved on 2007-10-05. November 16, 2004 "AFRL handed Palo Alto's Communications & Power

Industries a four year, \$7 million contract, according to the Hilltop Times — the in-house paper of Hill Air Force Base. "Dr. Diana Loree, the project officer for Active Denial, said four AFRL directorates are involved in developing this airborne capability: directed energy here; propulsion and vehicles at Wright Patterson Air Force Base, Ohio; and human effectiveness at Brooks City-Base, Texas. Experts from directed energy, as the lead directorate, focuses on the systems engineering and radiating system development, she said. Propulsion directorate experts focus on the airborne power generation and conditioning required for the radiating system. Vehicles directorate scientists and engineers put their efforts toward Active Denial's thermal management and aircraft integration issues while human effectiveness experts focus on biological effects research."

- G.-H. Bricet des Vallons, "The wave canon or the rheostatic mutation of armament", *Technology & Armament* n°2, july-september 2006.
- With Pain You will Protest - The paradox of the harmless weapon that can change democracy. (http://www.rainews24.it/ran24/inchieste/26022007_armainnc) Video from RaiNews24 (Italian TV) 26 February 2007

Military sites

- U.S. Air Force Research Laboratory's Directed Energy Directorate (<http://www.de.afrl.af.mil/>)
 - Active Denial System Factsheet (<http://www.de.afrl.af.mil/Factsheets/ActiveDenial.pdf>)
- Active Denial System (ADS) Advanced Concept Technology Demonstration (ACTD) (<https://www.jnlwp.com/ActiveDenialSystem.asp>) . *Joint Services Website (DoD, USA, USN, USMC, USAF, USCG, SOCOM)*. Retrieved on 2007-10-05.

Retrieved from "http://en.wikipedia.org/wiki/Active_Denial_System"

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