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## The U.S. Department of Defense Humanitarian Demining Research and Development Program

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*U.S. Humanitarian Demining Research and Development Program (HD R&D)*

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# The U.S. Department of Defense Humanitarian Demining Research and Development Program

In 1994, the United States initiated a research and development (R&D) program to develop new, internationally shareable technologies for humanitarian deminers and for U.S. troops performing peacekeeping and stability operations. The Humanitarian Demining (HD) R&D Program is part of the overall U.S. effort to assist with the global landmine problem.

by Sean Burke, U.S. Army Night Vision and Electronic Sensors Directorate

## Introduction

The Countermine Division of the U.S. Army Night Vision and Electronic Sensors Directorate (NVESD) executes the R&D program for the Office of the Assistant Secretary of Defense for Special Operations and Low Intensity Conflict (OASD(SO/LIC)). From the Pentagon, OASD(SO/LIC) provides funding, guidance and management oversight to the program. The NVESD Countermine Division is well-equipped to execute this program due to its extensive countermine engineering expertise, coupled with a world-class fabrication facility and access to excellent test facilities.

The HD R&D Program tests, demonstrates and validates equipment for immediate use in various international HD missions and environments. The goal is to transition new technologies to both military and civilian demining organizations. A key component of the

Mine Clearing Cultivator under construction in the NVESD prototyping facility.



program is to develop demining technologies and then to provide equipment to the international demining community to assess its capabilities in actual demining conditions. The program focuses on R&D technology development that reduces the time and cost associated with demining while improving operator safety. This is accomplished through adapting commercial-off-the-shelf equipment, integrating mature technologies and taking advantage of R&D activity in tactical countermine and UXO clearance. The program aims to improve on existing technologies for mine and minefield detection, mechanical mine and vegetation clearance, mine neutralization, individual deminer protection, and individual deminer tools.

## The Annual Requirements Workshop

At the heart of the development of demining equipment is a multi-year investment strategy driven by an annual requirements workshop. Each year, the HD R&D Program brings representatives from mine-affected nations together to identify and update their most critical needs. The annual HD R&D Requirements Workshop is one of the most important events of the program because it documents required capabilities that truly represent current deminer needs.



The most recent workshop, conducted in August 2002, included representatives from 12 governmental mine action organizations and five non-governmental organizations (NGOs) from Africa, eastern Europe, the Middle East and southeast Asia. The Organization of American States (OAS) and the Inter-American Defense Board (IADB) represented Central and South America. Workshop participants gave presentations on the current humanitarian mine action situation in their countries, received talks and briefings on the U.S. R&D Program, and witnessed demonstrations of several prototype demining technologies developed under the program.

The result of the workshop is a clear picture of where the HD R&D Program should focus its development efforts. With this knowledge, the Program Office structures its execution plan for the future and submits it to the Pentagon for approval. Once approved, design and development of prototype technologies begin. This is done inhouse using the NVESD Prototype Fabrication Shop as well as by awarding contracts to industry and academia. International market surveys are also conducted to help identify commercially available items that could be used or adapted for HD applications.

Upon completion, prototype items undergo developmental testing to ensure that all design requirements are met. If

test results identify engineering modifications that will improve the system's performance, the changes are made and the system re-tested.

## Operational Field Evaluations

Selected systems then undergo in-country operational field evaluations. Host nation-conducted operational field evaluations are one of the most important parts of the HD R&D Program because the equipment undergoes testing in actual mined areas. There is no better way to test the effectiveness and suitability of a prototype item. In-country field evaluations are extremely beneficial to the HD effort. They directly assist host nation demining efforts. They provide information needed to determine the prototype's suitability and effectiveness given the unique demining environment where the test occurs. The demining community is afforded the opportunity to "test drive" new equipment and technologies in their own environment prior to making procurement decisions. The outcome of these field evaluations allows the demining community to formulate cost-benefit analysis data to justify new technology procurements to the donor community. The demining environment includes the number, variety and type of mines; terrain; weather; and infrastructure. The evaluations provide the R&D Program Office "lessons learned" information that may result in system improvements for future funding. Evaluation reports also provide information to the entire demining community that could lead to further evaluations or procurement.

An operational field evaluation begins with a host nation request to the Pentagon. OASD(SO/LIC) will then organize a site assessment. The Site Assessment Team, which includes representation from the R&D Program Office, will assist the requesting nation to determine the most appropriate prototype equipment given the country's specific situation. The assessment process ends with a recommendation of the most suitable prototype and a decision to support the evaluation. Evaluations typically last for six

months to one year.

An important part of the HD R&D Program is the opportunity for supported nations to participate in the development of a specific technology from design through field evaluation. When a new development project is determined to be the best solution to meet the capability needed by a specific country, that nation has the opportunity to participate as the user member of the development team. The national mine action center will be kept up-to-date on the system's development progress and will be welcome to participate in meetings and observe development testing. In return, the host nation agrees to conduct an operational field evaluation of the system. The host nation benefits by being part of a technology development designed specifically for their problem. The R&D Program benefits from the information and experience gained by the operational evaluation.

## Technologies Developed by the Program

The HD R&D Program is responsible for keeping the military countermine and humanitarian mine action communities informed of its technology developments. The Program Office does so in several ways. Technologies developed are listed in the Developmental Technologies Equipment Catalog available on the internet, in hard copy and on CD-ROM. The Catalog is updated approximately every two years. Test results can be made available to organizations and individuals in the international demining community for consideration in making equipment investment decisions. In addition, the R&D Program maintains a website at <http://www.humanitariandemining.org>.

The HD R&D Program spans a wide range of technologies, encompassing mine and minefield detection, mechanical mine and vegetation clearance, mine neutralization, individual deminer tools, and personal protective equipment (PPE) for deminers. There is only enough space to describe a few of the technologies



(Left) Camcopter during test program. (Below) GEM 3.



developed by the HD R&D Program to date. For more information, refer to the information sources described above.

Current detection projects involve improved electromagnetic (EM) detection, various forms of ground penetrating radar (GPR), infrared cameras and chemical detection of explosive vapor from buried landmines. In the detection arena, the HD R&D Program has invested in a remote-controlled aerial sensor platform for wide-area detection. The Camcopter is a rotary wing unmanned aerial vehicle that can carry a variety of sensors for minefield detection. The R&D Program has used the Camcopter with infrared, optical and GPR systems to detect mined areas on and off road.

Although it is a handheld metal detector, the GEM-3 is a significant improvement over standard metal detectors used to find mines. The GEM-3 is a broadband digital sensor with target recognition software capable of not only detecting a mine, but also discriminating it from clutter.

Energy-Focused GPR (EFGPR), the Mirage Synthetic aperture radar (a 40-lb. unit mounted on the Camcopter) and the NIITEK Wichmann systems are all exploring various configurations of GPR to detect mines. The Handheld Standoff Mine Detection System (HSTAMIDS) is a dual sensor system consisting of a metal detector and GPR. This is one of several



(Left to Right) Rhino Earth Tiller. Energy-Focused GPR. Mirage GPR on Camcopter.



developments in which the HD R&D Program and military countermine programs work together. The HSTAMIDS will soon become the U.S. Army's new standard handheld detector. Its outstanding performance will benefit humanitarian deminers as well as soldiers. The Mine Detection and Detonation System (MDDS) is a Lion II mine-protected vehicle integrated with a three-meter metal detection array for area reduction.

Two successful mine neutralization technologies are Liquid Explosive Foam (LEXFOAM) and the HD Flare. These systems are alternatives to using C4 or other explosive means to destroy mines in place. LEXFOAM is a nitro-methane based stock solution and mixture of propellants that is packaged, stored and transported in two aerosol cans as Class 3 flammable liquid. It is not explosive until operators combine the two units and dispense the material on the mine. LEXFOAM is a blast-cap sensitive foam.

The HD Flare, using production excess space shuttle rocket fuel, is an effective low-order neutralization (by burning) device against thin-case landmines. New individual mine neutralization technologies are now in the early stages of development.

The HD R&D Program has placed a significant emphasis on developing technologies for mechanical mine and vegetation clearance. Examples of successful developments in this area are the Rhino Earth Tiller, the Mine Clearing Cultivator (MCC), the Mine Clearing Sifter, the Tempest, the Survivable Demining Tractor and Tools (SDTT), the Rotar, and the Mini-Mulcher (MAXX).

The Rhino Earth Tiller is a remote-

controlled, teleoperated mechanical system used for large-area AP mine clearance. It neutralizes mines buried up to 30 cm and can also operate in areas of heavy vegetation and small tree cover. It can withstand any AP mine blast and is repairable from AT blasts. The Rhino has been in Croatia since July 1998, and has undergone operational evaluations in Cambodia, Jordan, Israel and Korea. It is now being readied for its next deployment to Azerbaijan.

The MCC is a remote-controlled mechanical mine clearer for uncovering AT landmines on roads and in large open areas. Designed and fabricated at the NVESD prototype facility, the MCC mounts to a modified 200-hp class commercial bulldozer. The Mine Clearing Sifter, which mounts to the same bulldozer, clears AP and small AT mines from previously scarified soil and loose sand. The MCC and the Sifter are now undergoing an operational evaluation in Angola. Although the MCC is a solution for large open areas and roads, it is less suitable for small or hilly areas, or for vegetation-covered terrain.

The Tempest, is a small, remote-controlled AP mine blast-protected system designed to clear AP mines from off-road areas inaccessible to large-area mine clearers like the MCC. The Tempest is an excellent example of how an operational evaluation can lead to improvements that realize the potential of a prototype design. The Tempest began an operational evaluation in Thailand in January

2001. Although it was effective at clearing vegetation in mined areas, Thai operators identified overheating problems. The unit's promising performance warranted the investment of funds to improve the system. The resulting Tempest Mk. V is now a much more reliable and powerful system. The Tempest is produced in Cambodia, thus representing a regional capability in southeast Asia. The Thailand Mine Action Center (TMAC) continues to use the system, along with another mechanical assistance success story.

The SDTT is a modified commercial farm tractor used to support demining operations and quality assurance in heavily vegetated areas with AP mines. Steel wheels and eight attachments—including vegetation cutters, a roller, earth cultivators, a bucket loader, a rake, a magnet, a mine gripper and a tree extractor—make this a versatile system. The SDTT has also been operating in Thailand for nearly two years. The SDTT and Tempest have been an important part of TMAC's development of an integrated mine action program that encompasses manual demining, mine detection dogs, mechanical assistance and mechanical area reduction.

The Rotar is an area preparation multi-tool for vegetation reduction and soil sifting in landmine-suspect areas. Introduced to the R&D Program by the demining NGO Menschen gegen Minen (MgM—in English, People Against Landmines), the device has proven highly



effective at removing mines from loose soil, particularly berms and piles. MgM mounted the Rotar onto an 80-hp Caterpillar backhoe tractor. The R&D Program is testing the utility of Rotar with other host vehicles. One operational evaluation is currently underway in Mozambique. The HD R&D Program is mounting the device on a larger excavator as part of a mine clearance solution for Honduras and Mozambique.

Finally, the MAXX is a small remote-controlled vegetation clearer that can operate in very tight areas. The vegetation clearance attachments fit onto an articulated boom that can be extended and rotated 360 degrees around the unit. This allows the device to cut vegetation without having to enter the suspected mined area, saving the cost and weight of adding armor protection. Additional attachments are being considered for the MAXX system, as is planning for operational field evaluations in Rwanda.

Space does not allow the description of all prototype items developed under the HD R&D Program. To learn more, visit the Department of Defense (DoD) HD website at <http://www.humanitariandemining.org>, or contact the NVESD Information Office at 703-704-1288.

**Benefits**

The HD R&D Program has to date deployed equipment to nearly 30 countries. Besides providing valuable performance data to demining organizations and the R&D Program, these deployments have had a direct impact on the slow but steady progress being made to remove post-conflict landmines. The story of the Tempest and SDTT in Thailand is a prime example. In March 2002, the Thai government officially released cleared land along the Thai-Cambodia border to the civilian population. The HD R&D Program was an integral part of this important success.

U.S. troops also benefit from the HD R&D Program. First, when military units deploy for peacekeeping and stability operations, they move into areas where fighting has just ended and the danger of landmines is significant. They need the means to detect and clear all landmines in these areas. In addition, it is important to be able to detect re-mining activity by former warring parties. Some pieces of equipment developed by the R&D Program may be effective tools for peacekeeping and stability operations.

In order to examine the military utility of this equipment, the Army established the Joint Area Clearance Advanced Concept Technology

(Left) Rotar II. (Below) Mini-mulcher (MAXX).



Demonstration (JAC-ACTD). Several HD R&D technologies are now undergoing extensive demonstrations under the JAC-ACTD. Depending on the results of these demonstrations, the potential exists for introduction of this equipment into the U.S. military.

Also, U.S. soldiers are key players in establishing sustainable indigenous mine action capacities in supported countries. As part of the overall task of guiding the host nation to establishment of a national mine action office and conducting demining training, they can recommend technologies developed under the HD R&D Program. The HD R&D Program also benefits the Army as a whole because its efforts contribute to solving the humanitarian mine problem while assisting military countermine research.

The HD R&D Program continues to develop new technologies to improve the safety and efficiency of demining. The unique system of annual requirements workshops, the NVESD in-house design and fabrication capability, worldwide technology development and field evaluations has proven to be an excellent formula for success. ■

*\*All photos courtesy of the author.*

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(Left to Right) Mine Clearing Cultivator. Survivable Demining Tractor and Tools. Mine Clearing Sifter.

