CONTACT: John Toon/Ginger Pinholster
(404) 894-3444

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Photography Available

ARMY GETS WORLD'S LARGEST OUTDOOR COMPACT RANGE FOR TESTING ANTENNA PATTERNS ON FULL-SIZED MILITARY VEHICLES

The U.S. Army's Electronic Proving Grounds (USAEPG) at Fort Huachuca, Arizona has begun operational testing for what is believed to be the world's largest outdoor compact antenna range.

Designed and built by the Georgia Tech Research Institute (GTRI) under contract to the Army, the range will be used to measure how military vehicles such as tanks and helicopters affect the radiation patterns of antennas mounted on them. Those changes can degrade performance of the antennas.

"The Army is trying to make its communications and tracking equipment as effective as possible," said Georgia Tech Project Director Henry Cotten. "It is known that antenna patterns get changed when the antennas are placed onto vehicles. Getting information on these patterns will help the Army enhance equipment effectiveness."

Testing done on full-sized vehicles at the range will help the Army evaluate the best locations for installing antennas on its vehicles to minimize any loss of performance. The range can accommodate vehicles up to 70 tons in weight and up to 50 feet in length, testing frequencies from 6 to 40 GHz.

In the future, the range may also be used for limited radar cross section studies.

Antennas are normally tested using "far field" ranges, which consist of two towers whose separation depends on the size of the target and the frequencies being studied. One tower holds the antenna under test, while the other receives the signals.

Because the Army wanted to test full-sized vehicles over a wide range of frequencies, a conventional far-field range turned out to be impractical, Cotten explained.

"If you start getting larger objects and higher frequencies, the distances between the towers becomes larger," he said. "At high frequencies and with large targets, you are talking about towers many miles apart -- and the problems of maintaining two separate facilities."

To solve the problem, the Army elected to build a compact range, a type of antenna test facility normally built indoors. "The compact range allows them to generate the same kind of field at a much closer distance," he noted.

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The facility consists of two main components: a large parabolic reflector 75 feet in diameter and a positioner which rotates and elevates the targets. The positioner can hold vehicles as large as the Army's M-1 and M-60 tanks 42 feet off the ground for study.

"By turning the vehicle around and tilting it, you can look at the antenna pattern from all sides and angles of the tank," said Cotten. "You can look at all of its hemispherical coverage."

The information can be used to generate a three-dimensional plot of the antenna field. The plot may show antenna weaknesses in certain areas, meaning the vehicle might have difficulty receiving certain signals -- potentially leaving it vulnerable to hostile forces.

Gaining information about this antenna field pattern allows engineers to relocate the antenna or to install a supplementary antenna to offset the deficiency.

The compact range was set up to test frequencies ranging from 6 to 40 GHz, though it was designed to accommodate future expansion for testing frequencies up to 100 GHz. The rigidity of the structure and its smooth surface treatment should allow the range to be used at such higher frequencies, Cotten said.

"We tried to build in as much future capability as possible," he added.

Antenna measurements take place inside a "quiet zone" created by the test range. This quiet zone is an area where the electromagnetic fields are relatively stable, permitting accurate measurements.

In most compact ranges, a substantial portion of the reflector must be left inactive to allow electrical energy to dissipate at the edges. Without proper dissipation, the energy would create ripples and disrupt the fields under study. The requirement for an inactive area means most compact ranges can produce quiet zones only about half the size of their reflectors.

For the USAEPG range, Georgia Tech engineers used a special edge treatment that allowed them to use a much larger portion of the reflector. The special treatment, designed by Dr. Ed Joy of Tech's School of Electrical Engineering, consists of serrations or petals which dissipate the electrical energy in a relatively small area. (Georgia Tech has applied for a patent on the petal design).

The positioner and reflector were built by commercial firms under subcontract to Georgia Tech, though Tech was responsible for the overall design and integration of the facility.

The USAEPG had previously relied on an "arc" range which could measure frequencies of less than 8 GHz. The growing use of higher frequencies led the Army to develop a new facility.

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