WHO'S WATCHING THE NUKES?

The Air Force enhances security at its most sensitive, remote bases using vehicular repeaters.

By William Carlin

Photo courtesy of Department of Defense

For years, the U.S. Air Force has struggled with providing adequate communications using handheld radios on three of its largest complexes. Minot Air Force Base (AFB) in North Dakota, F.E. Warren AFB in Wyoming, and Malmstrom AFB in Montana all share the same problems. Remote locations surrounded by extreme terrain make handheld communications challenging at best, and when further complicated by severe weather conditions, communications can be nonexistent in some cases. In a time of heightened security concerns, the bases' coverage problems represented an unacceptable vulnerability.

Security forces are responsible for protecting missile launch facilities (LFs) throughout the bases and are required to operate under severe conditions to retake sites that have been breached. Command centers are typically established 0.5 to 1 mile away from the LF, safely outside the range of small-arms fire, while solders must approach sites on foot, taking defensive positions in culverts and drainage ditches.

Using 3- to 5-watt handheld radios, foot soldiers are the most vulnerable, and before the Air Force completed its communications upgrades, had the least-reliable coverage. Communication with a command center was spotty at best, and with a missile alert facility (MAF) nonexistent.

The Air Force's Force Protection Battlelab of Lackland AFB in Texas is charged with researching and bringing new technology to various divisions of the Air Force. The lab was designed to research and solve difficult security challenges outside normal bureaucratic channels. Lab officials locate high-technology, one-of-a-kind items and design and carry out field tests in the actual environment in which they would be used. Officials at the lab recognized the communications shortcomings that existed at the three nuclear weapons bases. In this case, if the tests solved the problem, the major command and unit would fund the purchase of the items to close the gap on vital security needs.

Many technologies were considered, including a satellite-based system. The action officer on the ground

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at the time had the idea of mimicking what the state highway patrol used, a vehicle-based repeater system. The goal of the highway patrol was to remain in contact with the control center from far away while on the road using handheld radios.

The security force's mission was similar, with hundreds of miles between the missile sites and the need to remain in contact with the control center and with other soldiers when outside their vehicles. After researching existing technology, officials evaluated in-vehicle repeater systems to help the portable coverage issues of security-forces divisions on the bases.

Minot AFB operates in the 405-425 MHz frequency band, and the Malmstrom and Warren bases use VHF frequencies. In all three cases, the bases wanted to operate the vehicular repeaters in the same frequency band as the mobiles, enabling security forces personnel to use only one handheld for direct and vehicular repeater-assisted communications. With the vehicular repeaters located close to the deployment of ground troops, soldiers could maintain clear and consistent communications not only with their command centers a mile away, but with the MAF located 40 to 55 miles away.

Real-World Tests

All three bases conducted extensive testing during February 2002 to simulate real-world and severe-weather conditions and to verify acceptance prior to payment. Units were bench tested and field tested in small quantities for proof-of-concept and frequency coverage verification in the different bands.

The tests were administered at 50 separate LFs located throughout the three missile complexes and witnessed by local forces and AF personnel. Two LF recapture exercises, simulating attack and the attempted theft of a nuclear weapon, were also conducted. On-scene commanders responded without repeater-equipped vehicles. They established command locations with unobstructed views of an LF outside small-arms range.

The response force vehicles, primarily Chevy Suburbans and military HumVees, were outfitted with Motorola Astro Spectra mobile radios. Pyramid Communications developed a series of high-selectivity filters that enabled a vehicular repeater to operate in band with the high-power mobile radios. The filters were necessary to eliminate interference that can occur when a mobile radio is transmitting at the same time a vehicular repeater is receiving, with both antennas in close proximity to each other.

A high-Q bandpass filter on the vehicular repeater's antenna line prevented the high-power transmitter from overloading the receiver front end. A mobile radio antenna coax needed an additional notch filter to reduce the transmitter phase noise that occurs on the receive frequency of a vehicular repeater.

Communications ranged from "weak and broken" to "nonexistent." Once the status of communication was established, radios linked to the repeater were put into place, which provided an instantaneous and drastic improvement in portable communications with the controlling agency and with response force members. Critical communications and command-and-control information were transmitted with 45 to 100 watts of power, providing more than 50 miles reach-back capability and saturation of the LF area with communications ability.

The overall success was judged by comparing communications with and without the vehicular repeaters. In every instance, the pre-existing legacy RF dead spots were eliminated or dramatically improved. If military forces came under fire while away from their vehicles, they could sound alarms and call for reinforcements when equipped with mobile vehicular repeaters, previously possible only from a vehicle. This allowed an on-scene commander to focus on tactics, techniques, and procedures of personnel as opposed to struggling with poor communications and directing response forces.

Local authorized two-way radio

dealer Kotana Communications of Williston, N.D., assisted with deployment and testing of vehicular repeaters, in addition to sales, installation, and training.

"We are extremely proud to have served our local military in such a way that provided a huge improvement in radio coverage. The personnel that were escorting us were awed that such a small package could provide such a vast improvement in handheld coverage," said Dave Erickson, service manager at Kotana.

The Minot Air Force Base in North Dakota

Reviving Dead Spots

The tests began at Minot AFB in North Dakota. All previous user-identified dead spots were tested with and without the repeater. One of the biggest dead spots was the Lake Darling area. Portable communications with the main base was impossible once users descended into the lake valley. With the vehicular repeater, portable communications throughout the entire former dead spot, including defensive positions from gullies and drainage ditches lining the roadway, was successful.

F.E. Warren's terrain consists primarily of flat prairie land. The temperature was 45 degrees below zero with wind chill, common winter weather in Wyoming, during some tests. Again, all known dead spots were tested and either eliminated or greatly reduced. Additionally, a recapture exercise was conducted with field forces. In the event of actual hostilities, vehicular repeaters enabled the controlling MAF to notify, form, and dispatch a properly armed backup force to assist with the recapture.

Malmstrom's test included a complete LF recapture with helicopter insertion of security forces. For LF recaptures, the terrain dictates the on-scene command location. Sometimes communications was strong; often it was nonexistent or spotty. Vehicular repeaters immediately and dramatically improved not only communications, but command and control as well. Dead spots were completely eliminated.

At one field test, with more than 60 on-site response force members, radio communications were degraded as normal. Once the repeater-equipped vehicle was turned on, the on-scene commander's transmissions simultaneously came across all 60 radios on scene for a dramatic effect. It worked equally well in Montana, Wyoming, and North Dakota.

At one site, the MAF controller responded to the radio check: "Extremely loud and clear ... How did you do that?" The three bases purchased 125 UHF (405-425 MHz) units with notch filters and 370 VHF (150-174 MHz) units with notch and bandpass filters. The equipment and labor purchased to get up and running cost $800,000. The repeaters are still in use.

The vehicular repeaters effectively eliminated the gaps in radio coverage at all three bases. At the conclusion of the evaluation, the commander of Force Protection Battlelab at the time made the following recommendation:

"Aggressively pursue additional frequencies and deploy mobile vehicular repeaters throughout the missile complexes. They instantly and dramatically improve critical communication and command and control of security forces. Where previously communication was absolutely impossible, it can now be established loud and clear. Nothing less can be accepted in the protection of nuclear resources. The equipment is inexpensive and commercially available." ■

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