Determining How Fast an Adversary Can Get Through a Chain Link Fence

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The fences surrounding nuclear power plants mark boundaries and help security personnel detect intruders and slow them down. But security managers may not know how effective the fences are within their overall security systems.

To address this knowledge gap, an LWRS Program team at Sandia National Laboratories (SNL) has conducted a comprehensive study to evaluate the effectiveness of 9-gauge chain link fencing, a material commonly used around government buildings and other secured sites. The LWRS team, the Access Delay and Structural Assessment Group, tested this fencing against established government standards [1]. The data will help in developing force-on-force scenarios and estimating the delay value of security hardware, information that plant security managers need but do not have much data for.

The team used a variety of attack techniques and tools. The researchers threw mock explosive charges to determine where and how a charge would land, tested to see whether an explosive charge would make a hole in the fence fabric big enough for an attacker to pass-through, and then assessed how long it would take for an intruder to breach. The work was done at SNL's Access Delay Lab, in Albuquerque, NM, and at the New Mexico Institute of Mining and Technology Energetic Materials Research and Testing Center, in Socorro, NM.

Figure 4. A simulated intruder throws a mock C-4 charge.

Between June and October of 2023, researchers threw 540 charges with mock explosives and conducted 20 hand-placed tests with actual C-4 explosives, charged through the holes in 16 tests, and cut fences in another 57 tests. This study included an evaluation of ten fence fabrics and meshes, though only the 9 gauge chain link fence fabric is discussed here [2].

A primary objective of the study was to see how often the testers could throw a charge so that it would land at an optimum distance (i.e., within 10 inches of the fence) and create a breach large enough for a person to pass-through. This was significantly more difficult than had been expected, with only a third of the thrown charges landing in this zone. About another third of the thrown charges landed between 10- and 18-in., which is much less likely to cause a usable breach. Anything beyond 18-in. would cause any damage to be negligible.

When the charge had hooks fastened to catch the fence fabric, as shown in Figure 4, 63% of the throws successfully attached to the fence. Of those, 55% caught the fence below a 50-in. height, which would result in a successful breach. Several of the hook charges were unintentionally thrown over the fence, well beyond the distance where any damage would be expected.

Testers also placed charges by hand, with one in contact with the fence, one at 10-in., one at 15-in., one at 20-in., and one hanging on the fence. Figure 5 shows the fireball created by the explosive charge, while Figure 6 shows the explosive damage to the fence from the charge that was hanging in contact. Then, an attacker pass-through attempt was conducted and timed for each test.

Figure 5. C-4 Charge explosive detonation fireball.

Figure 6. Explosive damage to fence.

In addition to measuring the performance of the barrier against explosives, the researchers also determined how long it would take an adversary to breach the fence with various hand or power tools, and then cross through the hole. Figure 7 shows mechanical breaching of the 9-gauge fence installation.

Figure 7. 8-in wire cutter and 36-in bolt cutter hand mechanical breach tests.

The researchers analyzed six scenarios involving a team of four attackers breaching a 9-gauge chain link fence with explosives, hand tools, and power tools. The delay times for these six scenarios ranged between 26 and 91 seconds.

While explosives contain an enormous amount of energy, their effectiveness against perimeter fencing depends on several factors. Among these factors are the size of the charge, its proximity to the fence, and the strength of the target. When conducting a task time delay analysis of any barrier, it is important to consider all the steps required to complete the operation, the time to conduct those steps, and the difficulty of achieving success. The full report [2] contains testing details and comprehensive results of all the fence fabrics tested, as well as their overall performance.

By providing data-driven insights into fencing effectiveness, the LWRS Program empowers nuclear power plant security managers to make informed decisions regarding security upgrades and resource allocation. This will both improve the ability of these officials to efficiently manage threats and security-related costs. Ultimately, this research will contribute to enhancing the safety and security of our nation's nuclear facilities.

Reference

1. Unified Facilities Criteria (UFC). (2013). "Security Fences and Gates." UFC 4-022-03, 1 October 2013. U.S. Department of Defense, Washington, D.C., USA.