CONF-8405119--1

PHYSICAL PROTECTION SYSTEM USING ACTIVATED BARRIERS

CONF-8405119--1

DE84 007303

Ronald E. Timm, Project Manager, Thomas E. Zinneman, and Joseph R. Haumann
Electronics Division

Hayden A. Flaugher, Program Manager, and Donald L. Reigle
Plant Facilities and Systems Division

Argonne National Laboratory
9700 S. Cass Avenue
Argonne, IL 60439

Abstract. The Argonne National Laboratory has recently installed an activated barrier, the Access Denial System, to upgrade its security. The technology of this system was developed in the late 70's by Sandia National Laboratory-Albuquerque. The Argonne National Laboratory is the first Department of Energy facility to use this device. Recent advancements in electronic components provide the total system support that makes the use of an activated barrier viable and desirable.

Typically, well-designed fixed barriers provide delays on the order of minutes to multiple, sophisticated adversaries. An equally well-designed activated barrier will improve the delay by an order of magnitude for the same threat. Further, it is desirable that the effects of an activated barrier be benign for equipment and personnel in the vital area.

The premise of an activated barrier is that it is deployed after a positive detection of an adversary is made and before the adversary can penetrate a vital area. To accomplish this detection, sophisticated alarms, assessment, and communications must be integrated into a system that permits a security inspector to make a positive evaluation and to activate the barrier. The alarm sensor locations are selected to provide protection in depth. Closed circuit television is used with components that permit multiple video frames to be stored for automated, priority-based playback to the security inspector. Further, algorithms permit "look-ahead" surveillance of vital areas so that the security inspector can activate the access denial system in a timely manner and not be restricted to following the adversaries' penetration path(s).

A physical protection system utilizing activated barriers can provide the delay necessary so that initial response can be accomplished by a smaller force. Hardening of vital areas can also be accomplished in a more cost-effective manner through the complementary use of an access denial system.

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Introduction

A basic physical protection system has three functional subsystems:

- DETECTION
- DELAY
- RESPONSE

The threat spectrum challenging these subsystems has sophisticated weaponry and techniques with personnel dedicated to the successful completion of their mission. The defeat of any one of the subsystems in a basic system is sufficient for the adversaries to successfully meet their objectives.

Advancements in detection technology have improved the efficiency of sensor components so that the probability of detection is nearly unity; layering of the sensors virtually assures detection. The improved training and equipping of the response force, particularly the addition of SWAT teams, ensures successful confrontation of the adversaries.

Delay is the security feature that ties together detection and response to defeat the adversary. In the past, barriers consisted principally of fixed delays, e.g., doors, walls, and fences; improvements consisted of bigger, thicker, heavier, and more. Since the mid 70's, research has been under way to provide a new type of barrier--an active barrier.[1] An active barrier is a component that is installed in a passive mode and is activated by a security inspector after the positive assessment of an adversary. When the activated barrier is deployed, a delay of 30 minutes or more is provided.

Physical Protection

Physical protection systems are often designed using a layered technique. Figure 1 shows a typical layered security system that provides protecion in depth for a vital area. The "yellow" zone is typically the perimeter of a Protected Area (PA); the orange zone is an intermediate zone, usually within a building; the red zone is directly outside a vital area and may include the Materials Access Area (MAA). Each zone has layered sensors of perimeter and volumetric alarms, with closed circuit television (CCTV) for assessment. As can be seen in Fig. 1, the yellow zone provides the initial detection for ground penetration, and the orange zone provides the first level of detection for airborne penetration. Further, the yellow zone, because of adverse environmental conditions, has a probability of detection considerably less than unity, and because it is the furthest out, with the longest perimeter, it is the most costly to construct. Therefore, the outside PA is the weakest detection point and the most costly to deploy. As the detection zone moves nearer to the vital area, it usually moves indoors, where it is environmentally less hostile, the perimeter becomes shorter, and detection is less costly. The inner defense zones are more easily controlled.

In the recent past, the layering technique, with emphasis on the Protected Area, was necessary because, after detection of the adversary, delay was provided by distance to travel plus a series of fixed barriers. Figure 2 shows a typical penetration diagram through the defense zones to a vital area for either an act of theft or sabotage. The fixed barrier system is only as good as it is deep. Improvement in distance was often not possible, and improvement in hardening barriers is expensive to implement. Further, the addition of fixed barriers often adversely impacted operations. With the advent of active barriers, a new option is opened. An active barrier can be located in a vital area, and, once it is deployed, can provide a delay of 30 minutes or more. Thus, the detection point shifts dramatically to the orange or red zones, where probability of alarm and assessment improves virtually to unity in all weather.

Barrier Technology

Barrier technology is divided into two classes--fixed or activated. The fixed barriers of doors, walls, etc., were briefly discussed above. The active barriers fall into four generic classes; cold smoke, aqueous foam, rigid foam, and sticky foam. Table 1 shows a matrix of characteristics. One of the most interesting aspects of the activated barriers is its effect on personnel and equipment in the vital area, if the barrier is deployed. Two of the activated barriers, rigid and sticky foam, are considered bad for personnel and equipment. The remaining two, aqueous foam and chemical smoke, are benign; in fact, neither are harmful to personnel, even if they are exposed throughout the persistancy of the deployment, and both are also not harmful to mechanical or electronics components. Total clean up time after deployment is on the order of a week.

Activated barriers are typically used with physical restraints. The activated barriers, together with the physical restraints, comprise an Access Denial System. The physical restraints are placed over and around the sensitive items in the vital area. Their purpose is to stop an adversary from grabbing and snatching a sensitive item even though an active barrier is, or has been, deployed. The synergistic effects on adversary movement in an active barrier environment, plus adversary action with a fixed restraint, means that a delay of 30 minutes can be achieved for an Access Denial System. Table 2 shows the relative effectiveness of fixed barriers and an access denial system.

TABLE 2. Typical Barrier Delays (Minutes)[2]

	Adversary(s) 1-man	2-men
F/xed Barriers		
Fences	0.12	--
Walls - 8"		
Block	0.8	--
Reinforced	--	1.9
Doors - Industrial		
Standard	0.2	--
Hardened	1.8	1.0
Distance (100 ft)	0.12	0.12
Activated Barrier (Smoke)		
ARM/FIRE	0.2	0.2
Deploy	1.1/1.6	1.1/1.6
Sustain	28.1/34.0	28.0
Restraint/Defeat	1.5	0.5

The deployment of an activated barrier requires: (1) the security inspector ARM and FIRE operation sequence, (2) barrier deployment time, and (3) barrier sustaining time. Obviously, the key to success for an activated barrier is the security inspector operation sequence. Additionally, the activated barrier equipment must be hardened to ensure its successful deployment. Since the equipment is located in the vital area, its hardening must be equivalent to that of the vital area perimeter, or approximately one minute for multiple adversaries in the red zone.

The cost of an Access Denial System, activated barrier and restraints, is on the order of $200,000. By almost any component cost comparison, this is cost effective. A simple cost comparison of fixed barriers vs an ADS for the same delay yields cost savings of greater than five to one. Further savings are effected by reduced demands on the response force; personnel can be assigned normal duties and emergency duties, rather than to one, exclusively.

Barrier Operation

Barrier operation consists of the successful detection of an adversary and successful security inspector ARM and FIRE operation sequence.

Successful detection of an adversary is achieved by the combination of two separate operation scenarios using the same detection equipment. The first operation sequence requires acknowledgement of alarms of ascending priorities (yellow, orange, and red), and their successful assessment using state-of-the-art CCTV technology. The modern CCTV technology consists of cameras and video switchers that are interfaced directly to the alarm processors. The output of the switchers provides realtime video to the security inspector TV monitors and stores discrete frames of video in memory devices. The stored images are played back for assessment simultaneously with the realtime video.

The tracking of adversary action is one operation sequence; the second operation sequence involves using the same CCTV system to survey the vital area for the coming of the adversary(s). This allows the security inspector to "look ahead" and to activate the barrier before the adversary(s) begins the attempt to enter the vital area. A vital area can have up to six exposed faces that an adversary could choose to penetrate. The most vulnerable face(s) would be the entrance(s). To scroll through the video of the six faces is not operationally effective, particularly in an installation having multiple activated barriers. Therefore, the "look ahead" video is displayed only for the entrance of a vital area until such time that an alarm is detected on any of the remaining five faces. With an alarm at the vital area, alternate cameras covering the entrance and the alarmed zone will be presented to the security inspector for assessment.

Assessment and surveillance require the action of two security inspectors to maximize the effectiveness of the active barrier. In most instances, high security installations have a central alarm station (CAS) and a secondary alarm station (SAS), each with one security inspector. Procedures have to be developed whereby the CAS security inspector has the responsibility of assessing the adversary(s), and the SAS security inspector has the responsibility for the "look ahead" surveillance of the adversary. In an emergency, either security inspector is capable of performing both the assessment and surveillance functions.

The joint operations action also lends itself to additional hardening of the activated barrier; that is, the barrier can be activated from either of the two locations, the CAS or the SAS. Further hardening of the activated barrier can be achieved by deployment of an activated barrier that will "fire or fail" when all control lines are deactivated.

Summary

Activated barriers have been under development since the mid 70's, but it is only with the recent advances in detection technology that they have become a viable component in a well-designed physical protection system. With the use of layered alarm sensors monitored by high-speed computer processors and integrated with modern closed circuit television, security inspectors are able to acknowledge and assess alarms accurately in tens of seconds. With timely information, a hardened activated barrier improves the delay time from minutes to tens of minutes. Another security inspector in a diverse location, using surveillance monitors in a complementary mode enhances the overall system effectiveness.

The successful delay of the adversary with the use of an Access Denial System means that the response force can provide an initial response with fewer personnel and have more time to deploy a final force to meet multiple, sophisticated adversaries. The use of activated barriers and restraints increases the response force deployment time from minutes to tens of minutes, particularly for theft scenarios. Even for sabotage, the time for a response force to effect action has the same order of magnitude improvement.

An Access Denial System (activated barrier and restraints), compared to fixed barriers for the same delay, yields cost savings of greater than five to one, with additional savings effected by reduced demands on the response force.

References

1. John W. Kane and Martin R. Kodlick, "Access Denial Systems: Interaction of Delay Elements," Proceedings, 24th Annual Meeting on Nuclear Materials Management, Vail, Colorado, Vol. XII, Institute of Nuclear Materials Management, pp. 301-306., July 1983.

2. Barrier Technology Handbook, Sandia National Laboratories-Albuquerque, SAND77-0777rev, 1981.

TABLE 1. ACTIVE BARRIER SELECTION MATRIX

	COLD SMOKE	AQUEOUS FOAM	RIGID FOAM	STICKY FOAM
PERSISTENCY	GOOD	MARGINAL	GOOD	GOOD
PREMATURE CONSEQUENCES	GOOD	GOOD	BAD	BAD
SAFETY	GOOD	GOOD	MARGINAL	BAD
VOLUME	LARGE	LARGE	SMALL	SMALL
COST	GOOD	GOOD	MARGINAL	MARGINAL
AVAILABILITY	COMMERCIAL	R&D	R&D	R&D

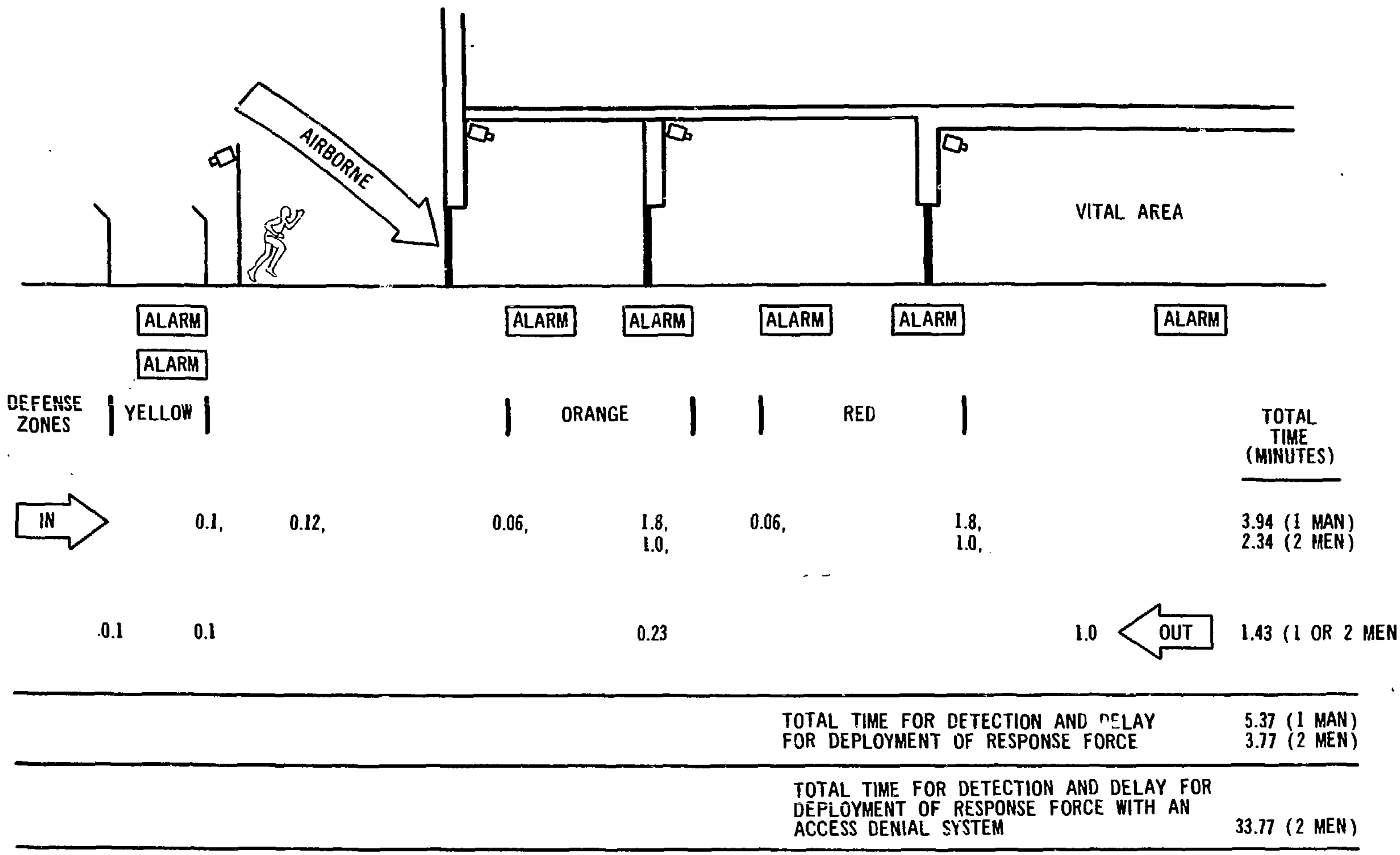

FIGURE 2. PENETRATION DIAGRAM

ARGONNE NATIONAL LABORATORY

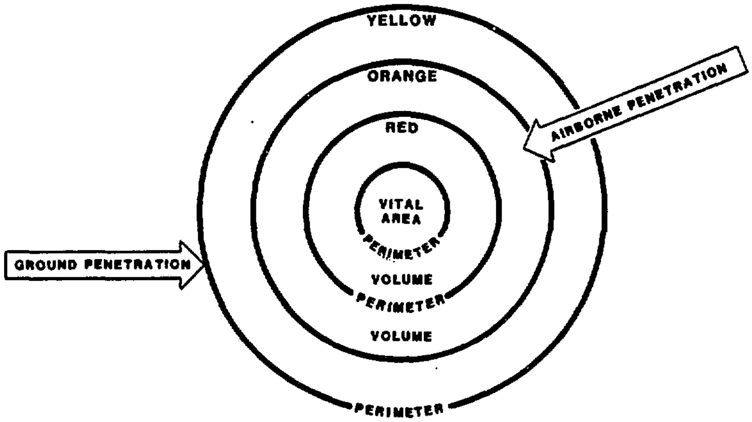

FIGURE 1. PROTECTION IN DEPTH