AD-A025 386

MODEL PHYSICAL SECURITY SYSTEM COMBINING HUMAN AND ELECTRONIC RESOURCES

AIR FORCE INSTITUTE OF TECHNOLOGY

17 MAY 1975

MODEL PHYSICAL SECURITY SYSTEM

COMBINING HUMAN AND ELECTRONIC RESOURCES

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THESIS

Submitted in partial satisfaction of
the requirements for the degree of

MASTER OF ARTS

in

CRIMINAL JUSTICE

at

CALIFORNIA STATE UNIVERSITY, SACRAMENTO

APPROVED:

[illegible], Chairman

[illegible], Second Reader

[illegible], Third Reader

Date: May 12, 1975

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CI-76-9	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) MODEL PHYSICAL SECURITY SYSTEM COMBINING HUMAN AND ELECTRONIC RESOURCES		5. TYPE OF REPORT & PERIOD COVERED Master of Arts Thesis
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) RICHARD D. KELLEY CAPTAIN, USAF		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS AFIT student at California State University Sacramento, CA		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Air Force Institute of Technology (CI) Wright-Patterson AFB OH 45433		12. REPORT DATE May 17, 1975
		13. NUMBER OF PAGES 125 pages
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for Public Release, Distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

JERRY C. HIX, Captain, USAF
Director of Information, AFIT

APPROVED FOR PUBLIC RELEASE AFR 190-17.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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INTRODUCTION

Since time immemorial, military commanders have placed guards around their essential resources to insure that the unit's fighting capability would not be weakened by surprise attack, sabotage, espionage or pilferage. In the United States Air Force, this task is performed by the security police. Officially, their mission is defined as:

> During normal conditions, security operations must provide capabilities for detection, alarm discrimination, armed response, and emergency expansion to counteract hostile and other threatening ground action against operational resources.... During emergency conditions, security operations must provide capabilities that will prevent or limit damage to operational resources.[1]

Security policemen are also utilized to provide each Air Force installation with law enforcement services. Although enlisted personnel performing physical security and law enforcement duties are both called security policemen, the two tasks are separate military occupations. Enlisted personnel are permanently assigned to either the physical

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[1]Department of the Air Force, Headquarters, USAF, "Air Force Regulation 207-1, 'Aerospace Systems Security Program,'" 5 January 1972, Washington, D.C., p. 4.

security or law enforcement function. Security police officers and non-commissioned officers in the top three ranks, Master Sergeant, Senior Master Sergeant and Chief Master Sergeant, may be assigned to either the physical security or law enforcement functions. This analysis addresses only the physical security function and all references to security policemen will refer specifically to personnel performing the physical security function.

Security policemen are primarily tasked with providing physical security for nuclear weapons, in storage, transit, and while mated to delivery systems. Other resources typically protected include command and control facilities, installation perimeters in hostile locations and other aircraft and facilities in direct support of general or limited war missions.

Analysis of the Air Force physical security system shows inherent weaknesses, primarily as a result of overdependence upon the use of human sentries posted to provide initial detection of hostile acts directed against the protected resources. In Part One, the human sentry will be analyzed, to include external factors related to his job performance, measurements of his job dissatisfaction, factors which may be related to his dissatisfaction, and qualitative

measurements of his overall efficiency at detecting threats to the resources he protects.

The Air Force has realized the general inefficiency of the human sentry, and in recent years has taken steps for his ultimate replacement through the use of electronic sensing devices. In Part Two of this paper, the Air Force's decision to rely on sensors for the detection function will be supported by a review of the technological state of electronic security devices, and their applicability to Air Force security requirements. Part Two will conclude with a discussion of electronic sensors currently programmed for Air Force utilization.

Part Three of the paper will present a proposed model of a physical security system combining human and electronic resources. It is the writer's belief that conversion to the electronic detection of hostile intruders will alleviate a significant Air Force personnel management problem while, at the same time, greatly increasing the security afforded the nation's aerospace resources.

PART ONE

THE HUMAN SENTRY

CHAPTER ONE

STATEMENT OF THE PROBLEM

Historically, Air Force physical security standards have relied upon the presence of the on-duty security police flight and passive security equipment such as fences, lighting and locking devices to protect essential operational resources. These measures appeared adequate and were not questioned until the Air Force was heavily involved in the Vietnam War.

The first major challenge to the sentry based physical security system occurred on 10 January 1972, at the Utapao Royal Thai Naval Air Station when enemy sappers successfully penetrated a security police protected B-52 mass parking and alert area.[1] The sappers succeeded in damaging three of the aircraft. The conclusion of the American presence in Southeast Asia, however, did not lessen the security threat to Air Force resources.

In the last several years organized terrorist

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[1]"Thailand B-52 Base Is Hit by Terrorists," Sacramento (Calif.) Bee, 10 January 1972, sec. A, p. 2.

activity has significantly increased to compound the general and limited war security threat. On 3 September 1974, the armory of the 217th Training Battalion, California Army National Guard was burglarized.[2] The theft included M-16 automatic rifles, grenade launchers, machine guns and hand weapons. The impact of such a thert would be extremely compounded if terrorists could successfully obtain a nuclear weapon from the Air Force's arsenal. Lessons learned in Southeast Asia and as a result of the terrorist threat have necessitated a re-examination of the traditional sentry oriented physical security system.

A physical security system which is dependent upon the human sentry for detection of hostile intruders is only as efficient as is the sentry's mental and physical alertness, motivation, state of training, and his strategic, defensive placement. Analysis of personnel performing sentry duty demonstrates that, as a group, they have disproportionate rates of disciplinary problems, drug abuse, job disqualifications due to mental and emotional problems, and low rates of job satisfaction. Equally important, Air Force security police officials have conducted intruder penetration tests

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[2]"Fresnan Arrested in Armory Theft," Sacramento Bee, 2 March 1975, sec. 2, p. 19.

which found that the human sentry had a detection probability of only 35 percent.[3] In the following chapters of Part One, the role of the security police sentry will be analyzed to determine the specific factors which negatively influence the performance of his assigned tasks.

[3]Security Police Directorate, Management Division to Director, Security Police, "Trip Report," 14 January 1974, filed at Security Police Directorate, Management Division, Headquarters USAF, Forrestal Building, Washington, D.C.

CHAPTER TWO

EXTERNAL FACTORS RELATED TO SENTRY PERFORMANCE

Introduction

This chapter will analyze four factors which tend to affect the performance of sentry duty. It will begin by examining the quality of the individuals selected for assignment to the security police career field. The number of personnel assigned duty as security policemen will be discussed in order to better understand the size and complexity of the problem confronting the Air Force's physical security program. Third, the supervisory force assigned to manage security personnel will be discussed. The quality of supervision in the security police career field has frequently been criticized and considered a significant contributing factor in the poor performance of security policemen. The chapter will conclude with a review of the tasks usually associated with sentry duty.

Quality of Input

The Air Force has not had to rely upon the draft to fill its enlistment quotas. As a result, entry requirements

are somewhat at the discretion and manipulation of the service. Applicants to the enlisted corps must pass a written examination and satisfactorily pass an induction physical that attests to the applicant's general health.[1]

Personnel selected for assignment to the security police career field must meet the following additional requirements:

1. No record of a personality disorder
2. A minimum score of forty on the pre-induction written examination, "Armed Services Vocational Aptitude Battery" (which is also the lowest score that may be received to be accepted into the Air Force)
3. No history of juvenile delinquency two years prior to assignment
4. No prior court-martial conviction
5. No prior reduction in grade or confinement resulting from Article 15, UCMJ, "nonjudicial punishment"
6. No prior convictions by civilian court except for minor traffic violations
7. Qualified to bear firearms
8. Completion of the basic security specialist school[2]

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[1]Air Training Command, USAF, Air Training Command Manual 33-2, "Recruiting Procedures for the USAF," 1 June 1974, Randolph Air Force Base, Texas.

[2]U.S., Department of the Air Force, Headquarters USAF, Air Force Manual 39-1, vol. 2: Airman Classification Manual (Washington, D.C., 29 December 1969).

Entrance to the career field is limited to males, on the basis of a federal law which precludes females from serving in combat.[3] Pre-service, limited drug experimentation does not preclude enlistment into the Air Force, nor does it preclude an assignment to the security police.[4] Drug abuse by active duty personnel does preclude their entrance or retraining into the career field,[5] and drug abuse by security policemen results in their removal from the career field.[6] Since October 1973, 70 percent of security police entrants have been volunteers.[7]

The entrance requirements for assignment to the security police career field have not proven successful at eliminating many men whose subsequent behavior is detrimental to the security police mission. In March 1974, officers

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[3]United States Code, Title 10, Section 8549.

[4]Department of the Air Force, Airman Classification Manual.

[5]Security Police Directorate, Resources Branch, Headquarters USAF, "Security Police Briefing to the Air Force Council," March 1974, p. 17. Files of the Directorate, Forrestal Building, Washington, D.C.

[6]U.S., Department of the Air Force, Headquarters USAF, Air Force Manual 35-99, "Human Reliability Program," (Washington, D.C., 15 May 1974).

[7]Security Police Directorate, "Security Police Briefing . . . ," p. 17.

of the Security Police Directorate, Headquarters USAF, briefed the Air Force Council, which is composed of senior policy making General Officers, on the quality of security police inputs. The focus of their presentation was sharp:

> Our problem in this particular area is simply that we are allowing personnel to enter the career field who are either not capable, qualified, or motivated to do the job.[8]

The high attrition rate of young security policemen out of the career field supports this allegation.

The Strategic Air Command (SAC), the largest employer of security policemen, analyzed its nonproductive personnel (i.e., those who had been relieved from duty), for the period 1 through 31 January 1974.[9] Just under 7 percent of the 14,000 SAC security policemen were in a nonproductive status in that month alone. Sixty-eight percent of these men had less than nine months' service time. More than half had been nonvolunteers for the career field. The reasons cited for their removal from duty were:

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[8]S.P.Directorate, "Security Police Briefing ...," p. 15.

[9]Director of Security Police, Strategic Air Command, "Analysis of Security Police Nonproductive Personnel. Period of Survey: 1 - 31 January 1974," Files of Director of Security Police, Resources Branch, Headquarters USAF, Forrestal Building, Washington, D.C.

1.	Drug involvement	36.5 percent[10]
2.	Mental instability	19.7 percent
3.	Absent without leave (AWOL)	13.4 percent
4.	Unreliable to handle firearms	4.4 percent
5.	Medical problems	3.8 percent
6.	Thefts	3.6 percent
7.	All others	18.3 percent

Security policemen in the lowest enlisted ranks are assigned sentry duty which places them in passive detection roles in sterile environments around the resources they protect. It is difficult to ascertain if the quality of airman input into the sentry positions plays the greater role in subsequent sentry misbehavior, or if the poor performance is a result of the inherent negative factors of the duty. It seems reasonable to believe it is a combination of both. The Air Force has initiated action to correct both possibilities. Since April 1974, all non-prior service entrants receive a security clearance before their assignment as security policemen.[11] Perhaps more important, the Personnel Research

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[10]Half of those removed for drug involvement were admitted drug experimenters before their military enlistment.

[11]S. P. Directorate, "Security Police Briefing . . . ," p. 17.

Division of the Air Force Human Reliability Laboratory is developing a program to conduct aptitude, motivation and psychological screening of security police entrants in order to identify and eliminate those ill-suited for security duty.[12]

The Security Police Directorate, Headquarters USAF, has also requested that pre-service drug experimenters not be allowed entrance into the career field. Headquarters USAF initially turned the request down, but the idea is still under consideration by the Department of Defense.[13] The sensitive mission of the security police and the demanding job requirements require careful screening and continued evaluation of all entrants to the career field.

Security Police Force Structure

There are a total of 33,000 security police authorized for the security and law enforcement functions in the Air Force, which constitutes 6 percent of the total enlisted force.[14] Security specialists make up two-thirds of the

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[12]Security Police Directorate, Resources Branch, Headquarters USAF, "Quality Improvement Briefing," undated, p. 7. Directorate Files, Forrestal Building, Washington, D.C.

[13]S.P.Directorate, "Quality Improvement ...," p. 9.

[14]S.P.Directorate, "Security Police Briefing ...," p. 9.

security police authorizations.[15] Seventy-four percent of security policemen are on their first enlistment (under four years of active duty), and over half are under twenty-one years of age.[16] The relative youth and inexperience of the career field is graphically displayed in Table 1.

Security police officers and non-commissioned officers in the top two ranks (E-8 and E-9), may be assigned to either law enforcement or security supervisory positions.

Security Police Supervision

The combined security police career field of security and law enforcement specialists is one of the largest in the Air Force, constituting one out of every sixteen enlisted personnel. Prior to 1 January 1975, there were only 744 officers and 434 senior non-commissioned officers in the two highest ranks authorized to manage the combined 30,000-man career field.[17] Because a security police squadron will fre-

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[15]Director of Personnel Data Systems, Computer Operations Division, Headquarters USAF, "Airman Force Analysis by Control Air Force Specialty Code, as of September 1974," Files of the Directorate, Resources Branch, Forrestal Building, Washington, D.C.

[16]Security Police Directorate, "Security Police Briefing . . . ," p. 33.

[17]S. P. Directorate, "Security Police Briefing . . . ," p. 53.

Table 1

ENLISTED SECURITY SPECIALISTS BY RANK

	E-1*	E-2	E-3	E-4	E-5	E-6	E-7	Total
Authorized	0	0	8597	5758	4466	1260	608	20689
Assigned	1130**	2475	6769	6650	3037	1150	374	21585

*Titles of the enlisted ranks are as follows: E-1, Airman Basic; E-2, Airman; E-3, Airman First Class; E-4, Sergeant; E-5, Staff Sergeant; E-6, Technical Sergeant; and E-7, Master Sergeant. Not shown in the table were E-8, Senior Master Sergeant, and E-9, Chief Master Sergeant.

**E-1's and E-2's are assigned where no authorizations exist because promotion to E-3 occurs fairly rapidly.

Source: Director of Personnel Data Systems, Computer Operations Division, Headquarters USAF, "Airman Force Analysis by Control Air Force Specialty Code, as of September 1974," filed at Security Police Directorate, Resources Branch, Headquarters USAF, Forrestal Building, Washington, D.C.

quently include both security and law enforcement sections, it is not possible to break down the specific number of managers assigned to either function. The ratio of managers to the lower enlisted ranks is significantly higher in the security police than is normally found throughout the Air Force. (See Table 2.)

The security police ratio of managers to lower enlisted ranks appears totally unrealistic in a career field in which the bulk of the enlisted force is young, relatively inexperienced, and assigned to protect nuclear weapons and other essential weapon systems. Supervisory tasks are further compounded by the fact that the duty of those supervised is characterized as dull, routine, and inherently unrewarding.

In recent months, the Air Force has taken some corrective action to improve the supervisor : worker ratio by attempting to bring the assigned level of supervisors up to their authorized strengths. Also, effective 1 January 1975, the number of lower grade officer authorizations (lieutenant and captain) were raised by 200.[18] These officers will be

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[18]Telephone interview with Captain Victor C. Ortloff, Security Police Directorate, Resources Branch, Headquarters USAF, Forrestal Building, Washington, D.C., 12 February 1975.

Table 2

OFFICER TO ENLISTED RATIOS

	Officer: Enlisted	E-9, E-8: Enlisted	E-7: Enlisted
Authorized			
Security Police	1:44	1:76	1:37
Total Air Force	1:5	1:25	1:10
Assigned			
Security Police	1:44	1:133	1:50
Total Air Force	1:5	1:31	1:11

Source: Security Police Directorate, Resources Branch, Headquarters USAF, "Security Police Briefing to the Air Force Council, March 1974, p. 34. Files of the Directorate, Forrestal Building, Washington, D.C.

assigned to fifty-six of the larger security squadrons to supervise the security flights during the hours between 1700 and 0800, when, traditionally, senior supervisors were not on duty. The Security Police Directorate, Headquarters USAF, is also working with manpower specialists to survey the non-commissioned officer supervisory positions to develop a more realistic supervisor:worker ratio. While the poor duty performance of security policemen cannot be entirely credited to the high supervisor:worker ratio, it must be considered a significant contributing factor.

Tasks Performed

The most frequently performed tasks by lower ranking security policemen require analysis in order to obtain a clear understanding of the basis for their generally poor duty performance. These are the tasks which would be most influenced by changing the function of the detection of hostile intruders from the human sentry to electronic sensing devices. Four security positions are usually assigned to the lower grade (E-1 through E-4) security policemen: security communicator plotter, dog handler, entry controller, and a composite position in which the airmen perform guard, sentry and security alert team member (response force) duties.

Information on these tasks was collected during a 1974 Occupational Survey of the Security Police Career Field.[19]

The position of security communicator plotter is normally assigned to an E-4 (sergeant). One-third of the communicator plotters surveyed also acted as supervisors, with five personnel being the average number supervised. The most frequently expressed level of job interest associated with the position was "fairly interesting." The average number of different tasks performed by the communicator plotter was forty. The five most frequently performed tasks were:

1. Operation of the central security control communications system (radio and telephone)
2. Maintenance of the communicator plotter board, charts and checklists
3. Routine dispatching of personnel and vehicles
4. Dispatching of response force members and other elements to security areas upon notification of actual, possible, or exercise penetrations
5. Performing emergency notifications in the event of incidents or accidents

The position is generally considered a favorable assignment by airmen because the duty involves a number of

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[19]USAF Occupational Measurement Center, Occupational Survey Branch, Air Training Command, "Occupational Survey Report: Security Police Career Field," Lackland Air Force Base, Texas, 1974, pp. A-2 - A-8.

different tasks, the possibility of acting as a supervisor and the opportunity to work indoors at bases where climatic conditions are often extreme.

The dog handler position is also usually held by men with the rank of E-4. Sixteen percent of the dog handlers who were surveyed held supervisory positions. Those who held supervisory positions averaged five men under their supervision. The position of dog handler is also popular, with "fairly interesting" being the most frequently expressed opinion of the duties required in the position. This position has the highest number of tasks (fifty) of the four positions discussed. The five most time-consuming tasks were:

1. Training dogs to obey verbal commands and gestures
2. Patrolling posts with dogs on their leashes
3. Exercising and grooming dogs
4. Training dogs to detect intruders
5. Training dogs to tolerate other handlers and dogs

The average rank of men performing as guard sentries and security alert team members was E-3 (Airman First Class). The number of men in these positions who performed supervisory duties averaged only 4 percent. Those who did supervise,

most commonly supervised four other airmen. The most frequently expressed level of job interest for these positions was "fairly dull." The number of different tasks associated with these similar positions was twenty-six. The five most time consuming tasks were:

1. Controlling entry into or within restricted areas
2. Performing guard duty in close proximity to Air Force resources
3. Challenging and identifying unknown persons
4. Responding to protected areas in response to actual, possible, and exercise penetrations
5. Performing guard duty around the perimeter of protected areas

Several factors account for the unpopularity of sentry duty. First, there are few distinctly separate tasks required, and those tasks which are required are uncomplicated and basically passive in nature. Second, there is little opportunity to act as supervisor. Third, the duty is performed outside, in all types of weather and climatic conditions.

The final position most frequently held by lower ranking security policemen is entry controller. This job is most commonly assigned to E-3's. Personnel filling the position have no opportunity to supervise. The most frequently expressed level of job interest for this unpopular position

was "very dull." Only seventeen uncomplicated tasks were discovered to be associated with the performance of the entry controller position. The five most time consuming tasks were:

1. Controlling entry into or within restricted areas
2. Responding to protected areas in response to actual, possible, and exercise penetrations
3. Controlling entry into restricted areas where an access badge system was employed
4. Challenging or identifying unknown persons
5. Apprehension or detention of offenders, suspects or intruders

The two most disliked security positions -- guards assigned to protect external areas and perimeters, and entry controllers -- have several things in common: they are assigned to the lowest ranking personnel, they have the fewest number of tasks associated with the function, the tasks performed are passive in nature, and there is little opportunity to supervise others. In Part Two it is suggested that these same job qualities that are unattractive to the security policeman easily lend themselves to accomplishment by electronic sensing devices.

CHAPTER THREE

MEASUREMENTS OF SENTRY DISSATISFACTION

Introduction

Security policemen, as a group, exhibit more signs of deviant behavior and inadaptability to their military assignments than do their cohorts in other Air Force occupations. This chapter will review the rates of security police disciplinary infractions, drug abuse, medical disqualifications, and will review security police job satisfaction studies.

Disciplinary Rates

Minor military offenses such as disobeying a lawful order, dereliction of duty, and misdemeanor criminal offenses are typically handled by the local squadron commander under the nonjudicial punishment provisions of Article 15, Uniform Code of Military Justice.[1] Table 3 presents an examination of the number of Article 15's given enlisted personnel at Mather Air Force Base, California, in 1974,

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[1]Uniform Code of Military Justice, Revised, 1969.

Table 3

ARTICLE 15'S* RECEIVED BY ENLISTED PERSONNEL E-4 AND BELOW BY SQUADRON

	Number of Personnel in Squadron	Number of Personnel Receiving Article 15's	Percent of Personnel Receiving Article 15's
Security Squadron**	99	30	33%
Law Enforcement Squadron	62	8	13%
Aircraft Maintenance Squadron "A"	159	8	5%
Aircraft Maintenance Squadron "B"	75	8	11%
Aircraft Maintenance Squadron "C"	161	30	19%
Aircraft Maintenance Squadron "D"	187	19	10%

*An "Article 15" is a form of nonjudicial punishment in which an immediate commander is authorized to take corrective action against a subordinate military member for minor infractions that do not merit a court-martial.

**Squadrons listed by order: 320th Security Police Squadron, Strategic Air Command; 323rd Security Police Squadron, Air Training Command; 323rd Organizational Maintenance Squadron, Air Training Command; 320th Organizational Maintenance Squadron, Strategic Air Command; and 320th Field Maintenance Squadron, Strategic Air Command.

Source: Article 15 information provided by the Office of the Staff Judge Advocate, 323rd Flying Training Wing, Air Base Group, Mather Air Force Base, California. Squadron personnel strengths provided by the Consolidated Base Personnel Office, Duty Status Branch, 322nd Flying Training Wing, Air Base Group, Mather Air Force Base, California.

showing that men in the security police squadron received a disproportionate number.

Security police involvement in major crimes is also higher than that of other career fields in the Air Force. The security police, with 6 percent of the Air Force's enlisted personnel, were involved in over 12 percent of the major crimes reported during the first six months of 1974.[2] (See Table 4.) During the same period, security policemen constituted over 15 percent of the prisoner population in the Air Force's 3320th Retraining Group.[3]

Drug Abuse

Security police involvement in drug abuse is consistently at least twice that which their percentage in the Air Force would indicate. During the first six months of 1974, they accounted for 12 percent (730) of the total Air Force drug criminal cases.[4] Analysis of the security police career

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[2]Security Police Directorate, Resources Branch, Headquarters USAF, "Background Criminal Statistics," in "Security Police Briefing to the Air Force Council," March 1974. Files of the Directorate, Forrestal Building, Washington, D.C.

[3]Security Police Directorate, Resources Branch, Headquarters USAF, "Quality Improvement Briefing," chart 4, p. 4. Files of the Directorate, Forrestal Building, Washington, D.C.

[4]Security Police Directorate, "Background Criminal Statistics."

Table 4

MAJOR CRIMES MOST FREQUENTLY COMMITTED BY SECURITY POLICE PERSONNEL*

	Total Committed by Air Force Personnel	Total Committed by Security Policemen	Percent
Assault	376	55	14.6%
Burglary	241	69	28.6%
Larceny	258	37	14.3%
Sex Offenses	423	31	7.3%
Theft of Government Property	263	26	9.9%

*Excludes drug-related crimes.

Source: Security Police Directorate, Resources Branch, Headquarters USAF, "Background Criminal Statistics," in "Security Police Briefing to the Air Force Council," March 1974. Filed of the Directorate, Forrestal Building, Washington, D.C.

field and other career fields which utilize a large number of lower ranking airmen clearly demonstrated the security police over-involvement in criminal drug abuse cases (see Table 5).

Human Reliability

The Air Force has established what it calls the "Human Reliability Program" to initially screen and to continually monitor personnel performing duties associated with nuclear weapons.[5] The initial certification consists of a medical screening of the individual's medical records. This is followed by a briefing of the individual on the purpose of the program, and a final certification if he is approved. Any sign of a personality disorder or evidence of unreliability requires a thorough psychiatric examination of the individual. If an individual is found to possess any traits that might compromise either the security or the safety of nuclear weapons, either during initial screening or after an individual is on the job, he will be removed from his position and reassigned.

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[5]U. S., Department of the Air Force, Headquarters USAF, Air Force Manual 35-99, "Human Reliability Program," (Washington, D.C., 15 May 1974).

Table 5

DRUG RELATED CRIMES BY CAREER FIELD

	Total* Cases	Assigned Strength	Percent of Air Force Strength	Percent of Involvement
Security Police	337	32,788	6.3%	12.9%
Transportation	125	20,052	3.9%	4.8%
Civil Engineers	89	13,658	2.6%	3.4%
Aircraft Maintenance	330	69,179	13.4%	12.6%
Supply	134	31,997	6.2%	5.1%
Administration	154	37,032	7.2%	5.9%

*Cases are for the first quarter, calendar year 1974.

Source: Security Police Directorate, Resources Branch, Headquarters USAF, "Background OSI Cases -- Drug Involvement," in "Security Police Briefing to the Air Force Council," March 1974. Files of the Directorate, Forrestal Building, Washington, D.C.

During the first half of 1974, there were over 17,000 security police positions under the Human Reliability Program, constituting 29 percent of the total Air Force participants in the program. During this same time, the security police accounted for 74 percent of the Air Force-wide disqualifications.[6] Disqualification of security policemen under the Human Reliability Program amounts to de facto removal from the career field, as over 90 percent of security policemen are under the program.[7] In 1973, 1,157 security policemen were disqualified, necessitating an expenditure of two million dollars in order to provide their replacements.[8] This number of disqualifications was almost equalled in the first half of 1974, and the total 1974 disqualifications when available for tabulation are expected significantly to surpass the previous year's figures.

The Directorate of Security Police, Headquarters USAF, has requested that Human Reliability screening be ac-

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[6]S. P. Directorate, "Quality Improvement ...," p. 34.

[7]Security Police Directorate, Resources Branch, Headquarters USAF, "Security Police Disqualifications Under the Human Reliability Program," background material for S. P. Directorate, "Security Police Briefing to the Air Force Council," March 1974. Files of the Directorate, Forrestal Building, Washington, D.C.

[8]S. P. Directorate, "S. P. Disqualifications ...."

complished for personnel selected to enter the career field immediately after they complete their basic training. Screening is currently done after the trained security specialist reports to his first duty station. The Directorate's suggestion, if accepted, would eliminate the training and assignment costs of personnel ill-suited to perform duty associated with nuclear weapons.

Job Satisfaction

There have been two major inquiries into security police job satisfaction and morale. The first was conducted over a four-year period from 1967 through 1971, by members of the USAF School of Aerospace Medicine.[9] The second was accomplished by the USAF Occupational Measurement Center during its 1974 occupational survey of the security police career field previously discussed in Chapter Two.[10]

The School of Aerospace Medicine study of sentry morale was done with two different groups of interviewees:

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[9]James F. Sanford, et al., "Alertness, Fatigue, and Morale of Air Force Sentries," Psychobiology Section, Neuropsychiatry Branch, USAF School of Aerospace Medicine, Brooks Air Force Base, Texas, October 1971.

[10]USAF Occupational Measurement Center, Occupational Survey Branch, Air Training Command, "Occupational Survey Report: Security Police Career Field," Lackland Air Force Base, Texas, pp. 12-31.

security police sentries stationed in the continental United States and security policemen assigned sentry duty in Southeast Asia during the Vietnam conflict.[11] There were 737 sentries surveyed in the United States and 177 in Southeast Asia. All interviewees were on their first four-year enlistment. The two most important findings of the survey were the highly negative responses to job satisfaction and intent-to-reenlist inquiries. Less than 25 percent in either of the groups voiced any satisfaction with their job, and less than 20 percent of those based in the United States and less than 10 percent of those in Southeast Asia intended to reenlist.

The most recurrent suggestion made by sentries (28 percent) for the improvement of morale was to improve the quality of supervision. Complaints of harassment by supervisors were frequently expressed to the survey takers. This "harassment" complaint points out a common dilemma for the security police supervisor. As pointed out in the supervision section of this chapter, the ratio of supervisors to workers in the security police is exceptionally high. Thus, the supervisor has little time to spend with each sentry on his post. The supervisor, aware of the sentry's low motiva-

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[11]Sanford, et al., "Alertness, Fatigue . . . ," p. 10.

tion and distaste for his duty, frequently spends his time with the sentry questioning him on his job knowledge and exhorting him to maintain his vigilance. While this approach appears necessary to the supervisor, it frequently compounds the sentry's distaste for his assignment.

The most disliked aspects of sentry duty found in the School of Aerospace Medicine survey were: the boredom and loneliness of being on post (23 percent), and the physical discomfort associated with sentry duty (19 percent). Finally, the survey found that the assignment as a security policeman was the most frequently reported (19 percent) disappointing factor of the interviewees' careers. The survey concluded with the generalization that sentry duty, under both war and peacetime conditions, is inherently unrewarding and that it results in security policemen having low morale and poor attitudes toward their work.

The second study, conducted by the USAF Occupational Measurement Center, was based on a random, world-wide sample of over 5,000 security policemen (15 percent of the total force).[12] One important finding of the study was that most

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[12]USAF Occupational Measurement Center, "Occupational Survey Report," p. 3.

security policemen could not expect any major change in the types of tasks assigned to them during their first four-year enlistment. Thus, those aspects of the job that security policemen find distasteful upon entrance into the career field will not appreciably change, even with additional years of experience and several promotions in rank.

The study found little change in the reenlistment potential of the first term security policemen than was found in the earlier study. Sixty-eight percent of the respondents did not expect to reenlist. Twenty-seven percent reported that they found the level of job interest in their assignment to be extremely dull, and just under 70 percent found their duty to be uninteresting. Fifty-one percent of the respondents felt that their training and talents were utilized either very little or not at all. For purposes of comparison, scores from first term airmen in twenty other career fields indicate that only 9 percent found their job extremely dull; only 40 percent found their jobs uninteresting; and only 32 percent felt that their talents and training were utilized either very little or not at all. Finally, the survey found that a full 74 percent of the security policemen would retrain into another career field if given the opportunity.

The disproportionate disciplinary rates, incidents of drug abuse, disqualifications under the Human Reliability Program and the expressed dissatisfaction with sentry duty all point to the inherently negative tasks the lower enlisted personnel of the security police are called upon to perform. In the following chapter, the work environment that leads to this dissatisfaction will be discussed.

CHAPTER FOUR

VIGILANCE AND SENTRY PERFORMANCE

Introduction

The rise of assembly-line production in industry and the development of radar in World War II drew the attention of psychologists to man's ability to remain vigilant while monitoring equipment in order to detect signals which require a human response.[1] H. N. Mackworth, a pioneer in the study of "vigilance," studied airborne radar operators because of his concern over the following factors which, he felt, could influence their ability to detect enemy intrusions on their radar screens:

1. The task was prolonged.
2. Often the task was a matter of "waiting for nothing to happen."
3. "False alarms" were not unusual.
4. The operator worked in isolation save for occasional telephonic inter-communications.
5. No check on efficiency was made.[2]

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[1]Carl M. Stroh, Vigilance: The Problem of Sustained Attention (Oxford, Eng.: Pergamon Press, 1971), pp. 1-2.

[2]D. R. Davies and G. S. Tune, Human Vigilance Performance (London: Staples Press, 1970), pp. 42-43.

The same factors which concerned Mackworth about the ability of radar operators to detect intruders apply equally to the security police sentry. The one difference between the two is that today the military employs radar systems which automatically signal the detection of intrusions on the radar screen.[3] Until the detection function of the Air Force's physical security system is converted to electronic sensors, the problems of sentry vigilance will continue to be a matter of primary importance. This chapter will analyze studies of sentry alertness and discuss aspects of the job which may negatively influence the performance of sentry duty.

Measurements of Sentry Alertness

In 1967, the United States Air Force School of Aerospace Medicine was tasked with determining the efficiency of security police sentries and identifying those factors which would tend to influence the alertness of the sentry negatively.[4] The resulting study was done in two phases: phase

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[3] Stroh, Vigilance, p. 3.

[4] James F. Sanford, et al., "Alertness, Fatigue, and Morale of Air Force Sentries," Psychobiology Section, Neuropsychiatry Branch, USAF School of Aerospace Medicine, Brooks Air Force Base, Texas, October 1971, p. 1.

one studied sixty-four sentries at four bases in the United States, and phase two studied forty-five sentries at four bases in Southeast Asia.

In phase one, the sentries were tested by measuring their response times to a buzzer and a series of lights placed in one quadrant of a circle approximately fifty feet from their posts. In phase two, the buzzer was eliminated as the detection scores of phase one subjects were not significantly different between the lights and the buzzer. Automobile headlights were used as the light source, with each containing an eight by twelve inch number which was clearly visible to the sentry by day and night. One of the six lights (only three were used in phase two), was randomly illuminated at varied intervals (fifteen-minute mean time). The sentry called out the number of the light when he detected it. The response time was recorded by the experimenter by a stopwatch set at 1/5-second intervals. In phase one, the buzzer was activated at random intervals, four times per hour. The subjects were tested throughout their eight-hour shift.

The results of the alertness tests differed between phase one -- stateside based sentries -- and phase two -- Southeast Asia based sentries. The phase one sentries showed no

appreciable decrement (reduction in alertness) during their eight-hour tour (mean time responses were approximately five seconds at the start of the tour and approximately six seconds at the end of the tour). The response time for phase two sentries, however, increased linearly from the start of the tour (five-second mean response) through the sixth hour (fourteen-second mean response). During the last two hours for their group, sentry alertness improved slightly (twelve-second mean response).[5]

The study was also designed to measure subjectively the level of the sentry's fatigue throughout his eight-hour tour. In phase one, both the sentry and his supervisor hourly filled out a check-list which consisted of ten statements such as "very lively," "extremely tired," etc., in order to identify most closely how the sentry felt or was judged to feel throughout his shift. In phase two, only the sentry completed the subjective fatigue checklist, due to the fact that in the previous phase, differences between sentry and supervisory rating were small and nonsystematic. In both

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[5]Many writers studying work and performance have described the phenomenon of "end-spurt" which is increased work activity that occurs when a worker knows his task is nearly completed. See John F. Catalano, "Effect of Perceived Proximity to End of Task Upon End-Spurt," Perceptual and Motor Skills 36 (2) (1973): 363-372.

groups, sentries began their tours relatively refreshed, but became progressively fatigued as the number of hours they were on duty increased. Although the Southeast Asia based sentries had the most noticable decrement in alertness, they reported feeling less fatigue than did the sentries based in the United States.

The loss of alertness reported by the School of Aerospace Medicine is less than that generally reported by writers who have studied vigilance. Ditchburn reported that the vigilance of military "look outs" began to deteriorate almost as soon as they began their tasks.[6] Mackworth found that his subjects missed 15 percent of their signals after thirty minutes, 25 percent were missed after an hour, and decrementation continued thereafter, although at a slower pace.[7] Davies and Tune, reviewing commonly reported vigilance phenomena, found that most decrement occurred during the first thirty minutes of a vigilance task and that subjects who knew they would have a long watch experienced decrement almost immediately.[7] Jerison found that when his subjects knew that

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[6]Reported in Davies and Tune, Human Vigilance Performance, pp. 39-40.

[7]Reported in Davies and Tune, Human Vigilance Performance, pp. 42-43.

[8]Davies and Tune, Human Vigilance Performance, pp. 115-116.

they were to have a long vigilance task they experienced much sharper degrees of decrement than those subjects who did not know the length of their vigilance task.[9]

The authors of the School of Aerospace Medicine report on sentry alertness did not offer an explanation as to why the sentries based in the United States did not experience vigilance decrement, although they did offer a suggestion as to why those based in Southeast Asia did. They first noted that they had expected that the sentries in a combat zone would be more alert than those based in the States. They suggested that the opposite finding could be attributed to the previously discussed fact that morale and job satisfaction were much lower among security policemen in Southeast Asia. Thus, the poor morale and low job satisfaction of the sentries were reflected in their duty (vigilance) performance.

Review of initial reports of the two phases of the study, however, provides a more plausible explanation for the limited amount of vigilance decrement reported in the final report. The initial report on the vigilance of Southeast Asia based security police sentries noted that despite the

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[9]Harry J. Jerison, "On the Decrement Function in Human Vigilance," in Vigilance: A Symposium, eds. Donald N. Buckner and James McGrath (New York: McGraw-Hill Book Co., 1963), p. 208.

double motivation of being posted in a combat zone and of being tested:

> 10 of the 45 sentries tested were found to be non-responsive /to the test stimulus/ and several were non-responsive multiple times. A sentry was judged to be non-responsive when he had not responded to the light after sixty seconds. At this time all three lights were then turned on to insure he was not busy looking at another area. In most cases, the experimenter would have to yell at the sentry to get him to respond, in addition to lighting all three lights. To prevent contamination and skewing the statistics, several of these non-responsive subjects were eliminated from the mean times . . . .[10]

A similar difficulty occurred during the testing of the sentries based in the United States. Here, the preliminary report noted that: "There was a substantial percentage of missing data." The report explained, "Extremes of weather made testing impossible because the sentry was usually completely isolated within his parka." Further testing disruptions occurred due to high levels of ambient noise and activity caused by aircraft being worked on in the alert area.[11]

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[10]Raymond E. Steinkerchner, "Preliminary Report of 7 AF Stress and Fatigue Study on Security Police," attached to cover letter, Chief of Staff, Headquarters Seventh Air Force (PACAF) to All 7 A. F. Bases, "Security Police Stress and Fatigue Study," 6 December 1969. Files of the Security Police Directorate, Resources Branch, Forrestal Building, Washington, D.C.

[11]Bryce O. Hartman, "A Field Study of Sentry Fatigue," USAF School of Aerospace Medicine, Aerospace Medical Division (AFSC), Brooks Air Force Base, Texas, 1 December 1968. Files of the Security Police Directorate, Resources Branch, Forrestal Building, Washington, D.C.

The men who served as subjects for the School of Aerospace Medicine study of sentry fatigue were on-duty security policemen tasked with providing security for Air Force resources in a combat zone, and nuclear weapons in the United States. The fact that a significant portion of the sentries could not be utilized in the reporting of the study, because of inattentiveness and lack of perception due to restrictive clothing, ambient noise and high levels of activity around the posts, has serious implications. The important question must be, would these sentries have detected the presence of a hostile intruder making every effort to conceal himself? A study by Bakan found that tasks requiring a high state of vigilance had a soporific effect on most subjects, and that the subjects in the experiment were not capable of continuous concentration, even among motivated subjects.[12]

Finally, as reported in Chapter One, intruder detection tests conducted by security police officials has established the human sentry detection probability at only 35 percent. The evidence suggests that the human sentry is incap-

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[12]Paul Bakan, "An Analysis of Retrospective Reports Following an Auditory Vigilance Task," in Vigilance: A Symposium, eds. Buckner and McGrath, p. 99.

able of providing the measure of security required for the protection of the Air Force's essential resources.

Duty Hours

The School of Aerospace Medicine study on security policemen also analyzed the average amount of time per month that the men spent on and off duty. The average time committed to Air Force requirements by security policemen was approximately 270 hours per month. This included major time consuming tasks such as time spent on the eight-hour sentry post, time spent traveling to work, guard mount, training, and time spent on alert and standby. Time spent off duty, i.e., free time, averaged 449 hours per month. Air Force intrusion into off-duty time was the most frequently reported (22 percent) complaint related to the security police job.[13]

The study also analyzed other career fields that had high duty hours in order to provide a comparison to the security police duty schedule. C-5 and C-141 cargo aircraft crews were working about 230 hours per month in 1967. Aircraft maintenance crews were averaging between 190 and 235 hours per month, depending upon the type of aircraft serviced. It

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[13]Sanford, et al., "Alertness, Fatigue, and Morale . . . ," p. 15.

should be pointed out, however, that aircraft and maintenance crews were supporting a wartime mission in which aircraft were heavily committed. While flying and maintenance times have significantly dropped since the end of the Vietnam conflict, the same has not occurred with the security police. In fact, with the current increased terrorist threats, the mission of the security police requires a greater commitment by the security force. One final comparison of work schedules noted in the study was that the conventional work schedule in civilian life is 170 hours per month.

Another aspect of sentry duty is that security policemen frequently work on rotating shifts. One commonly used schedule is to rotate the security police flight on a three-day shift of day duty, then three following days spent on the swing shift, followed by three days on the midnight shift. After nine continuous days of duty, three days off are given before restarting the cycle again with three-day shifts. There are several variations to the nine-day shift cycle, and a few units have established longer cycles of rotation, such as ninety days on one shift before recycling to another shift time. It is likely that the continuous shift movement is upsetting to the psycho-physiological balance of the sentry, and consequently, detrimental to Air

Force security.

Taub and Berger investigated the influence of shifts in the sleep-wakefulness cycles of subjects in vigilance and calculation tests. They found that shifted sleep patterns, compared to normal, stabilized sleep patterns, impaired performance on vigilance and calculation tests and induced significantly greater levels of anxiety, fatigue and unfriendliness in their subjects. They concluded that: "Altering the time in the circadian rhythm of habitual sleep is detrimental to performance on perceptual and cognitive tasks and mood."[14] In their comprehensive review of vigilance studies, Davies and Tune concluded that both mental fatigue and sleep deprivation impair the performance of vigilance tasks.[15]

The movement among security police units to more stabilized tour shifts appears to be warranted and should enhance somewhat the generally ineffective performance of the human sentry.

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[14]John M. Taub and Ralph J. Berger, "Acute Shifts in the Sleep-Wakefulness Cycle: Effects on Performance and Mood," Psychosomatic Medicine 36 (2) (1974): 164-173.

[15]Davies and Tune, Human Vigilance Performance, pp. 183-184.

CHAPTER FIVE

EFFECTIVENESS OF THE HUMAN SENTRY

The traditional reliance by the Air Force on the security police has been challenged by the increased security threat and the questionable detection capability of the human sentry. The security threat today must include the possibility that physical security may be compromised by curiosity seekers, anti-military protesters, acts of espionage and sabotage in either cold, limited, or general war environments, and by terrorists seeking access to nuclear weapons or other essential military resources for purposes of gaining a military advantage, blackmail, or public notoriety.

The security police are called upon to provide physical security against intruders through deterrence, detection, alarm communication, response, discrimination and, where necessary, the use of force. All aspects of this security system are dependent upon the initial act of detection. Analysis of the sentry, who is tasked with the detection function, raises serious questions about his efficiency and, hence, the effectiveness of the entire system.

The current selection criteria for security police recruits have proven to be insufficient when measured against the number of security policemen who subsequently must be reassigned to other career fields or eliminated from the service because of behavioral and duty performance problems. The security police supervisor-to-airman ratio is almost nine times larger for officers to airmen and three times larger for senior noncommissioned officers to airmen than that generally found in the Air Force. This is in spite of the fact that the security police career field is one of the largest in the Air Force, and that the greatest majority of airmen are young and relatively inexperienced. The problem of motivating airmen to perform the detection function is further compounded by the fact that it involves only a few uncomplicated tasks, and is performed in relative seclusion in a sterile environment.

Analysis of behavioral traits of the security policemen who serve as sentries also gives reason to question the use of men in the detection function. Security policemen traditionally have high rates of minor criminal behavior and major criminal rates are consistently 12 percent of the Air Force total, whereas the security police constitute only 6 percent of the personnel in the Air Force. Similarly,

security police yearly drug abuse rates are consistently around 12 percent of the Air Force total and they account for almost 75 percent of disqualifications under the Human Reliability Program. Finally, job satisfaction and morale surveys find the lower ranking security policemen, as a group, disenchanted with the Air Force and highly negative toward their assigned career field.

Analysis of the specific capability of the human sentry to detect intruders has also cast a shadow upon the entire physical security system. Human vigilance studies have found that a person's ability to discriminate and select proper stimuli decreases over time, and is influenced by mental and physical fatigue. Security police working hours per month are very high and the airmen frequently work on rotating shifts. The combination of low job satisfaction and morale, long duty hours and time spent in work related activities, and frequent change of sleeping patterns must exert some influence on their ability to maintain vigilance on post. Finally, the intrusion detection tests conducted by the security police, which found that sentries could only detect 35 percent of intruders, must be considered as an indictment against the use of the human sentry.

The real danger of hostile actions being directed

against essential Air Force resources, coupled with a questionable security system, seriously threatens the combat capability of the Air Force. There is strong justification for the development of a more advanced security system that is less dependent upon the human sentry. In Part Two it will be suggested that the detection function could be more adequately performed through the use of electronic sensing devices.

PART TWO

ELECTRONIC SENSORS

CHAPTER ONE

ELECTRONIC SENSING DEVICES SUITABLE FOR PHYSICAL SECURITY SYSTEMS

Introduction

In Part One, it was demonstrated that the security police sentry was incapable of providing the detection capability required to protect Air Force resources adequately. Primary reliance on the use of human sentries results in a degraded security system and, at the same time, creates personnel management problems that result in the expenditure of additional time and money. In Part Two, the state of the technological development of electronic sensing devices will be analyzed, and equipment that can provide the Air Force with a reliable detection capability will be suggested. Part Two will conclude with a discussion of electronic sensing devices already integrated into the Air Force's physical security system.

The discussion of electronic sensing devices in this chapter will be limited to those which are applicable to Air Force security requirements. There are four primary cate-

gories of sensor systems: entry control equipment, point sensors, internal area sensors, and external perimeter and area sensors. The devices will be described, their typical detection and range patterns discussed; and the inherent advantages and limitations of each will be considered. The chapter will conclude with a brief description of the necessary prerequisites for an effective sensor control center.

Entry Control Equipment

Entry control facilities must be designed to prevent access to all unauthorized personnel, yet be flexible enough to identify rapidly and allow entrance to authorized personnel. Entrances designed with two locked doors are particularly effective in maintaining orderly access. The person desiring entrance to an area should be required to ring a bell at the external door to obtain entrance from the controller. Once inside the access point, his access credentials should be verified before he is allowed to progress through the second, interior door. Electronic equipment is now available to allow for centralized operation by the access monitor at the central control center.

Closed Circuit Television

The placement of a closed circuit television system

at the access control point allows a centrally located controller to view several entrances at one time as effectively as if he were actually located at the access point. Most systems utilize videocon tube cameras which sense variations in light sensitivity and converts them to an electrical video signal.[1] The video output is connected to the receiver in the control center by coaxial cable. Cameras can be equipped with remotely switched lenses to provide both coverage of the entire access point and closeup coverage of the visitor.

A modification to the transmitter can provide an audio radio frequency which allows sound from the entrance point to be transmitted to the controller. Glick describes a split-screen modification which provides closeup viewing of the visitor and his access pass.[2] Similarly, video tape recorders can be connected to the system to record any unusual activity at the access point.

The use of overhead quartz-halogen lamps provides

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[1]Detailed discussion of closed circuit television is provided in Leo G. Sands, Electronic Security Systems (Indianapolis, Ind.: Howard W. Sams and Co., 1973), pp. 187-212.

[2]Barry Glick, "Access Control by Closed Circuit Television," Proceedings of the 1973 I.E.E.E. Electronic Security Systems Seminar Conference (New York: Institute of Electrical and Electronic Engineers, 1973), p. 11.

sufficient illumination and picture quality for the identification of personnel. The advantages of closed circuit television include:

1. One centrally located controller can monitor all access points, thus eliminating a controller at each point.
2. The entry controller is protected from attack.
3. A record can be made of unusual situations at the access point.

There are two primary limitations to the system:

1. It is a passive device which requires additional control equipment such as remotely operated door locking devices.
2. Personnel with counterfeit access passes may be admitted, as may those whose access has been withdrawn but who still retain an authorized pass.

Intercom System

A simple intercom system may be placed at the access control point and the access monitor's station to allow for dialog between the two points. The intercom is advantageous in that it reduces the cost and complexity of the closed circuit television system by eliminating the need for the audio portion and in the added benefit of allowing the controller to talk to the visitor.

Card-Lock System

The card-lock system is designed to allow authorized visitors access to restricted areas without the necessity of an access monitor's supervision. Entrance is gained by placing a properly encoded pass into a monitoring receptacle which automatically unlocks the entrance door.[3] A simple method of encoding the card is to impregnate it with a magnetic material. The receptacle contains a magnetic detector which is keyed to the impregnated pattern in the card. The receptacle throws the door locking switch when the correct code is presented. The principal advantages of the system are its simplicity and low cost. Several serious disadvantages, however, preclude its employment by the Air Force without additional safeguards. First, it will allow unauthorized personnel access with a proper card. Second, the card can be passed back through the door to allow others its use. Third, no personal verification by an access controller is provided.

Personal Identifiers

A more sophisticated and reliable system than the card-lock is the personal identifier.[4] Personal identifiers

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[3]Detailed discussion of the card-lock is provided in John E. Cunningham, Security Electronics (Indianapolis, Ind.: Howard W. Sams and Co., 1973), pp. 108-109.

[4]Glick, "Access Control . . . ," pp. 7-9.

are connected with a computer in the control center. The computer's memory bank stores, depending upon the system, the fingerprints, voiceprint, or handprint of authorized visitors. The visitor, at the entry point, performs the necessary identification act, i.e., placing hand or finger or speaking into the identifier. The computer then reads the exemplar, searches its memory bank for prior authorization, and unlocks the access door upon approval. The handprint, to date, has proven the most effective of the three systems. Advantages of the personal identifier include:

1. A fully automatic capability
2. Immediate updating of the computer's memory bank of new and terminated authorizations
3. Availability of a computer printout showing specific entrance and exit transactions

The system's disadvantages include:

1. The current unreliability of the finger and voiceprint systems due to frequent malfunctions
2. The present requirement for access control monitoring by closed circuit television or other means because of the system's lack of perfection

Evaluation of Access Control Equipment

Air Force security requirements require positive identification of personnel authorized into areas requiring access controls. A mix of closed circuit television with

intercom capability and the handprint personal identifier will provide the Air Force with the most reliable access control system.

Point Sensors

Point sensors are designed to alert the security sensor monitor to the presence of an intruder at a specific point. Point sensors are required by the Air Force at entrances to nuclear weapon storage bunkers and at the location of nuclear loaded alert aircraft. The point sensor is designed to alarm before an intruder can obtain access to the interior of the protected spot.

Magnetic Door Switch

This alarm is composed of two parts: a magnet fastened to the inside of the door and a magnetically actuated read switch positioned on the door frame opposite the magnet.[5] The proximity of the two parts when the door is closed actuates the switch, which sets up the on-alarm system. When the door is opened the contact is broken and an alarm is given. The contacts are balanced in the read switch in order to

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[5]Eugene L. Fuss, "Handbook of Modern Alarm Systems, Part I," Security World 11 (June 1974): 21; and "Protection Systems' Contact Devices, Part I," Security World 11 (November 1974): 69.

defeat an attempt to bypass the system by using an externally placed magnet to maintain the on-alarm circuit when the door is opened. An external magnet will cause the contacts to go off-balance, causing an alarm. The magnetic door switch provides several advantages:

1. No physical contact is required between the magnet and the read switch, thus no exacting tolerances are required.
2. Components are protected from the weather by being encapsulated in a glass housing.
3. The system is not susceptible to tampering since the parts are not exposed and redundant switching provides a fully supervised alarm circuit.

The disadvantages are:

1. Persistent vibration will cause false alarming.
2. The door may be penetrated by cutting or peeling without actually opening the door.

Door Switch

Microswitch Door Sensor

This is a single part, mechanically activated switch which is installed on the door frame.[6] When the door is closed it holds the alarm's spring-loaded switch in either a closed or open system. When the door is opened, the spring

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[6] P. Chleboun and K. M. Duvall, An Evaluation of Small Business and Residential Alarm Systems, vol. 1 (Mountain View, Calif.: G.T.E. Sylvania, Inc., Security Systems Dept., 1972), pp. 4-55 and 4-57.

is released and an alarm sounds. The advantages of the microswitch are its simplicity and reliability of design and the fact that it is less susceptible to vibration-caused false alarming than is the magnetic switch. The system's disadvantages are similar to those of the magnetic switch and, in addition, the fact that it requires close alignment at all times between the door and the frame.

Photoelectric Beambreakers

This detection device projects an infrared beam from a source to a receiver.[7] When an intruder steps into the beam he breaks the input to the receiver, causing it to abruptly reduce its energy level, which activates the alarm. The invisible quality of infrared prohibits the intruder from detecting and bypassing the beam. Several modifications of the system can be made. The sender and receiver can be housed in the same unit by reflecting the sender's beam back to the adjacent receiver via a mirror. The light source may also be modulated through an oscillator or disc at both the sending and receiving ends in order to prevent the intruder from

[7]Detailed discussion of photoelectric beambreakers is provided in Cheboun and Duvall, . . .Alarm Systems, p. 58; Sands, Electronic Security Systems, p. 58; and Fuss, "Handbook of Modern Alarm Systems, Part I," pp. 21-22, and "Contact Devicer, Part IV," Security World 12 (February 1975): 21 and 46.

supplying an alternate light source and thus preventing an alarm when he breaks the original beam.

The photoelectric system may be placed either on the interior or exterior of the protected door. The device can protect wide areas such as access ramps from alert aircraft parking areas to the active runway. The maximum range for infrared systems is 250 feet. The advantages of the system are:

1. The length of the area which can be protected
2. The adaptability of the system through the use of mirrors to reflect the beam at angles

The disadvantages are:

1. The system is susceptible to false alarming by dust, smoke and snow.
2. The beam can be circumvented if its presence is known to the intruder, by either avoiding contact with the beam or altering the beam with mirrors.

Capacitance Sensors

Capacitance sensors are used to protect specific resources, such as parked aircraft.[8] The sensing element is a capacitor. The aircraft is grounded through the device

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[8]Capacitance sensors are discussed in Cunningham, Security Electronics, pp. 53-63; and William F. Arnold, "Electronics Guards Parked Planes," Electronics 45 (October 9, 1972): 69-70.

which is placed alongside the aircraft. The device is battery charged and has two sensing wires. The sensing wires are connected to different analog oscillators with built-in digital logic designed to eliminate false alarming due to lightning, rain, snow and birds. One sensing wire acts as a reference and the other is used to detect changes in capacitance between the wire and the ground when an intruder approaches. The change in capacitance changes the amount of current flowing in the system which triggers an alarm.

The capacitance sensor protects the entire skin of the aircraft and extends coverage out several additional feet. Major advantages of the system include:

1. The entire aircraft and sensing device are within the protected area.
2. The system is portable.
3. The alarm will not be disturbed by activity in the area.

The primary disadvantage is that the system requires sensitive adjustments to preclude false alarming.

Evaluation of Point Sensors

The flexibility and general reliability of the magnetic door switch fulfills Air Force requirements more adequately than does the microswitch or the photoelectric sensor. The magnetic switch should be supported by an interior,

area sensor in the protected building to identify attempts to cut or peel through the door. The capacitance system is an effective device for protecting unguarded aircraft.

Interior Area Sensors

Interior area sensors are designed to detect the presence of intruders in structures such as nuclear weapon storage bunkers. The sensors are effective for detecting the presence of intruders who successfully bypass door sensors or who "stay behind" when a building is secured.

Ultrasonic Intrusion Sensors

This sensor sends ultrasonic waves from a transmitter to all areas in a protected room.[9] A receiver picks up the energy directly from the transmitter plus some of that which is reflected from the walls, ceiling, floor and other objects in the room. The combined waves strike the receiver at a constant rate. Movement by an intruder breaks up the wave pattern and disturbs the constant input to the receiver which causes the alarm mechanism to activate. The typical range for a single unit is twenty feet. Additional units

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[9]Cunningham, Security Electronics, pp. 27-38; Chleboun and Duvall, . . .Alarm Systems, pp. 4-65 and 4-66; and J. S. T. Charters, "Electronics and Security Systems," Electronics and Power 18 (18 July 1972): 266-268.

will provide the coverage necessary to protect any sized room. There are three principal advantages to the ultrasonic sensor:

1. Flexible coverage is provided to all areas in a room.
2. The presence of the system cannot be detected.
3. It is an effective method in detecting "stay-behind" intruders.

Two disadvantages to the system are:

1. It is possible to jam or trigger the unit with ultrasonic energy.
2. Elaborate circuitry is required to preclude false alarming caused by air movement from airconditioning units and forced air heaters, and disturbances caused by a telephone bell.

Microwave Intrusion Sensors

The microwave sensor is similar in operation to the ultrasonic system, except that it uses radiowaves in lieu of sound pressure waves.[10] This system provides greater coverage than does the ultrasonic, up to 300 feet, and has the same inherent advantages. It has the additional advantage of not being disturbed by mass air movements. Several disadvantages, however, make it less efficient than the ultra-

[10]Chleboun and Duvall, . . .Alarm Systems, pp. 2-67 and 4-68; and Cunningham, Security Electronics, pp. 39-51.

sonic sensor:

1. Microwaves can pass through wood and glass, thus the system can be activated by external movements in the path of the microwaves.
2. The system's power density cannot exceed ten milliwatts per square centimeter without being potentially harmful to humans.
3. High power radar units in the vicinity of the alarm system can disrupt its functioning.

Passive Infrared Sensors

The passive infrared sensor is designed to detect the presence of an intruder by reacting to his body's radiated infrared energy.[11] The system consists only of a receiver, which constantly monitors the level of infrared radiation in the protected area. It establishes an infrared heat reference level and activates an alarm when an intruder's presence abruptly changes this level. One unit is sensitive to an area approximately twenty feet by twenty feet. The system's advantages are:

1. Low false alarm rates if the room temperature is kept constant;
2. The system cannot be activated by personnel on the exterior of the protected room.

The primary disadvantage is that the sensor's sensitivity is

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[11] Chleboun and Duvall, . . .Alarm Systems, pp. 4-69 - 4-70; Sands, Electronic Security Systems, pp. 69-71.

lessened if the intruder's temperature is similar to the room's ambient temperature or if he wears protective clothing.

Passive Acoustic Sensors

This system utilizes a microphone or geophone to pick up sound waves.[12] The receiver is connected to an amplifier and a trigger circuit. Noise levels above a pre-set ceiling cause an activation. The range of the system is omnidirectional, and is limited only to the sensitivity of the receiver. High sensitivity, however, is susceptible to false alarming caused by ambient noise. Several modifications can be made to the unit to limit unwanted sound activations. An external receiver can be placed outside the building to pick up external sounds. This receiver is connected to a separate audio detection panel which senses the noise before it is sensed by the internal sensor, and through an output relay, prevents the internal system from alarming. The system can also be connected to a speaker to allow the sensor monitor to listen in when an alarm sounds, and thereby to determine the source of the sound. A more sophisticated modification feeds the noise input into an integration

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[12]Fuss, "Handbook of Modern Alarm Systems, Part I," pp. 22, 24; and Chleboun and Duvall, . . . Alarm Systems, pp. 4-66 - 4-67.

circuit, with a memory bank. Activations by noises similar to those "memorized" will not cause an alarm unless they are repeated a specific number of times within a pre-set time period. The modified capability to allow the monitor to listen in upon notice of an activation is the system's primary advantage. The disadvantages include:

1. A high susceptibility to false alarming, even with filtering devices
2. A reduced efficiency where sound absorbing materials are located in the protected area

Evaluation of Interior Area Sensors

Serious limitations in all the different sensor systems indicate that a combination of systems, i.e. redundancy, is required to offset the limiting factors of those sensors employed. The ultrasonic sensor, supported by a passive infrared system, are compatible and provide overlaps for each other's limitations.

External Area and Perimeter Sensors

External area sensors provide security coverage for nuclear storage sites, alert aircraft ramp areas, and other high priority areas during periods when authorized personnel are not present. Perimeter sensors are deployed around these areas in order to provide full-time security at the outermost

ring of defense. Frequently, the perimeter sensors are used in conjunction with physical barriers. Externally placed sensors require specific capabilities in order to withstand extreme variations of weather and geography. Sensors must be designed to provide the greatest possible ability to distinguish between intruder penetration attempts and background noises and traffic.

Closed Circuit Television

This device, discussed under Entry Control Equipment, above, also has applicability in area and perimeter security. Units may be placed to pan wide expanses of area or placed in a permanent configuration to provide coverage along a perimeter. A low light level capability is required on external closed circuit television systems.[13] Low light level television utilizes image intensifiers which can provide a readable image in visibility down to 10^{-4} lux, which is equivalent to a moonless, cloudy night. As the sensor monitor will have other duties, he should not be expected continuously to monitor the receiver. Motion detectors, in the form of a digital computer, can be coupled with closed circuit television to activate the monitoring screen and a warning

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[13] W. E. Anderton, "Industrial Security," Wireless World (December 1973), pp. 603-604.

alarm when an intruder appears before the camera.[14] Another modification is to tie the computer in with independent area and perimeter sensors to activate the television system when an alarm occurs. With appropriate lenses and sufficient cameras, the system can provide the Air Force with visual coverage for all of its area and perimeter requirements. The primary advantage of closed circuit television is that it can eliminate the need for area and perimeter sentries, yet still be responsive to penetration attempts. The primary disadvantage of the system is that repair and maintenance require trained specialists.

Vibration Detectors

Although vibration detectors have traditionally been utilized as interior sensors, they do have applicability as external sensors. The vibration sensor is basically similar to the audio intrusion detector except that instead of using a microphone it uses a movable coil and a stationary magnet as the alarming device.[15] Motion vibrations upset the magnetic field in the sensor which activates the alarm. The sensitivity of the alarm can be adjusted to screen out many

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[14]Sands, Electronic Security Systems, pp. 90-97.

[15]Cunningham, Security Electronics, pp. 70-71; and Fuss, "Handbook of Modern Alarm Systems," pp. 24-26.

low level vibrations not associated with human movement. The range of the sensor is circular with a maximum of twenty feet in the best of soil conditions. Its advantages are:

1. Placement and adjustment of the device is simple.
2. The device can be used in a variety of settings, soil, fences and on posts.

Disadvantages include:

1. When sensitivity is increased for maximum range, false alarming may occur from non-human vibrations.
2. Changes in the ambient environment such as rain or snow may affect the unit's sensitivity.

Photoelectric Beam Breakers

This system, discussed previously under Point Sensors above, is also applicable in area and perimeter security. An infrared beam can be reflected by mirrors to provide overlapping coverage of an open area. External use of the photoelectric beam breaker is subject to the same advantages and limitations of the internally used system.

Radar Sensors

This system, while having a radar-like effect, is actually an antenna-loading device.[16] It utilizes a mono-

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[16]Sands, Electronic Security Systems, pp. 71-74; and Chleboun and Duvall, . . . Alarm Systems, pp. 4-68 - 4-69.

pole antenna coupled to the tank circuit of an oscillator. Energy from the antenna strikes the intruder and is reflected back to the antenna which alters the antenna's reactance. This alteration causes a frequency shift in the oscillator which is processed to activate an alarm. The maximum range of the device is approximately twenty-five feet. The primary advantage of this system over most exterior sensors is that its coverage forms an effective penetration wall twenty feet high at its thickest point. The system has two disadvantages:

1. The antenna is omnidirectional.
2. Frequent false alarming occurs due to occasional sensitivity of the system beyond its normal range and also due to radio frequency interference.

Magnetic Detectors

This detector utilizes a magnetometer which automatically adjusts to the earth's magnetism.[17] The presence of an intruder carrying any metallic object will disturb the magnetic field around the sensor and cause it to alarm. The range of detection varies with the placement of the sensor and the amount of metal carried by the intruder. Generally, the range varies from three to six feet. Its primary advan-

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[17]Cunningham, Security Electronics, pp. 78-82; and Sands, Electronic Security Systems, pp. 74-76.

tage as a sensor is that it is very effective at identifying metallic objects, and intruders often have metal in their possession. The device has two basic limitations:

1. If the sensor's position is known to the intruder, he can avoid the area or carry no metallic objects.
2. Animals, birds and foliage which touch the device will cause an alarm.

Pressure Sensors

Several different devices can be employed to detect intruder movement via pressure disturbances.[18] One device is similar to the microswitch door sensor discussed under Point Sensors, above. Here, a switch is closed when pressure is applied to the device, allowing current to activate the alarm. Another device consists of two liquid filled hoses laid parallel to each other. When one of the hoses is stepped on, the previously equal pressure of both hoses is upset, and a monitoring device activates the alarm. Mercury switch sensors use a mercury ball within a switch as the alarming mechanism. In a stable environment, the ball is

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[18]Security Police Directorate, Resources Branch, Headquarters USAF, "A Planning Guide for the Application of Ground Sensors to Physical Security and Air Base Defense," 16 March 1973, pp. 2-3. Files of the Directorate, Forrestal Building, Washington, D.C.; and Sands, Electronic Security Systems, p. 44.

disengaged from surrounding electrodes in the switch. Movement around the device will cause the mercury ball to roll into the electrodes, causing the closure of an open circuit which activates the alarm. The range of pressure sensors is limited to the immediate surroundings of the device. The advantage of these devices is that they can be placed in a concealed position in the ground or on existing perimeter fences. The primary disadvantage is the sensor's susceptibility to false alarming caused by birds, animals, adverse weather conditions and non-hostile traffic.

Proximity Capacitance Sensors

The proximity sensor for aircraft, which was discussed under Point Sensors, above, can also be used on chain-link perimeter fencing.[19] Two parallel sensing wires are run close to the fence. An intruder will set off the alarm as he approaches. Changes in humidity, temperature, or movement of the fence are detected equally by the sensing wires, thus precluding false alarming. In addition to the advantages listed under Point Sensors, the capacitance fence can detect tunneling activity under the fence.

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[19]Cunningham, Security Electronics, pp. 56-57.

Evaluation of External Area and Perimeter Sensors

Early detection and warning of intruders is a prerequisite of security. Externally placed sensors can provide the security police with the necessary time to respond to an activation with an adequate force. Because of the greater possibility of false alarming with exterior sensors, a closed circuit television with low light level capability is very functional. It can serve as an effective method of identifying the cause of an alarm and of guiding a responding force. The use of the other sensors should be made as the sensor, task and surroundings dictate. The different capabilities of each make each suited for specific tasks and environmental conditions. The appropriate sensor system must be selected through the use of careful security planning and analysis. Use of laser beam technology has not been discussed in this paper as a possible sensor system. This technique is being developed and appears to have high applicability to physical security systems. As the state of technical knowledge of sensor systems continues to develop, refinements of old techniques and development of new concepts will make sensing devices an even greater aid to effective security. The security planner must keep abreast of these advancements in order to maintain the best possible level of security available to

the military mission.

Sensor Monitoring Station

Sensors should annunciate at a central sensor monitoring station. This will allow for centralized reporting of alarm activations, their assessment, and the dispatching of the response force. A central location allows for the hardening of the center to provide for the necessary security of this vital link in the system. The center's primary tasks should involve the management of the sensor system and the deployment of the response force. A redundant display system is required at a separate location to provide backup to the primary center and to act as a real time monitor of the primary center's activities.

Sensor Data Transmission

Sensor activations may be transmitted to the control center via hardwire or radio frequency transmitters.[20] The advantages of hardwire transmissions are:

1. Its low material costs, simplicity of design and reliability
2. It can be monitored to detect malfunctions and tampering.

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[20]Chleboun and Duvall, . . . Alarm Systems, pp. 4-75 - 4-78.

Its primary disadvantage is that it is often difficult and expensive to install so that it is not visibly exposed to the intruder. Radio frequency transmission systems have the advantage that they are easily installed in conjunction with the sensor. It has several major disadvantages, however:

1. The signal cannot be protected and it may be jammed.
2. False alarming may occur due to interference from or crosstalk on other systems or radio frequency emitters.
3. The signal is only passed to the receiver when an activation occurs, so the monitor cannot otherwise tell if the sensor is functioning.

The hardwire transmission of alarm signals is preferred over the radio frequency, unless the laying of wires is not practical or a requirement exists for a mobile unit that can be deployed immediately.

Sensor Monitoring Station Requirements

A variety of monitoring units exist. Use of specific units will depend upon the types of sensing devices employed and the unique monitoring requirements required. Regardless of the specific equipment used, certain capabilities should be included in the system.[21] The monitor should be able to

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[21]Cunningham, Security Electronics, p. 88.

determine that each sensor is operative, and be warned if the sensor or wiring is tampered with. He should be able to tell which sensor has been deactivated due to the presence of authorized personnel in the protected area. Finally, the arming/disarming of sensors should occur at the control station rather than at the sensor. The control station should also include: (1) display maps, (2) controlled door releases, and (3) radio and telephone communications. The primary consideration in establishing the control center is that the various components are compatible, and the existing system is adaptable to changing security needs and new technological developments.

CHAPTER TWO

APPLICATION OF ELECTRONIC SENSING DEVICES TO AIR FORCE SECURITY REQUIREMENTS

In the preceding chapter's analysis of the state of the technological development of electronic sensing devices it was shown that sensors, used properly and with redundancy where required, can serve more effectively than the static sentry. The Air Force has conducted tests of perimeter sensors, without redundant placement, and found them consistently detecting penetrators with accuracy percentages in the high nineties.[1] Replacement of the sentry, however, does not eliminate the necessity of a strong security force. Sensing devices can serve no other purpose than that of a security aid to the security police. The modern security system must combine human and electronic resources to achieve the desired level of security for the Air Force's needs.

Electronic security devices integrated into the Air Force's security system must meet both specific and general

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[1] Security Police Directorate, Management Division, to Director, Security Police, "Trip Report," 14 January 1974. Files of the Directorate, Forrestal Building, Washington, D.C.

requirements. The Air Force has a worldwide mission and electronic security devices must meet this capabil v. Equipment selected for the security police inventory must, therefore, be operable in all environmental and geographical conditions encountered throughout the world. This requires a variety of devices sufficiently encompassing different designs and operating characteristics that may be called upon to provide a specific function in a given location. Similarly, the equipment must be inexpensive enough to be procured and maintained under peacetime budget limitation, yet effective enough to meet wartime conditions.

In the past, the Air Force has utilized electronic sensing devices where a security need could be met by an existing sensor. Sensor technology has now advanced to the state where equipment can be designed to meet existing needs. Such a capability can lead to the procurement and proliferation of single purpose devices. The Air Force has recognized this paradox and has instituted management action to insure that electronic devices will be developed with sufficient design to be fully integrated into its broad security system.[2]

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[2]Security Police Directorate, Resources Branch, Headquarters USAF, "System Concept for Base and Installation Security System," 7 May 1973. Files of the Directorate, Forrestal Building, Washington, D.C.

Essentially, the Air Force requires the minimum number of different sensors which provide the greatest operational capability in a variety of situations. Additionally, the individual devices must be modular and interchangeable in order that a worldwide deployment capability can be maintained.

An essential concern in applying sensing devices to Air Force requirements is that they provide immediate, real time notification of an intrusion. All alarmed locations will not require the same number of responding security policemen nor the same response time. An activation at an access control point can be covered by fewer policemen than an alarm at an unguarded, nuclear loaded, alert aircraft. Similarly, the response time to the alert aircraft must be quicker than to an alarm at a perimeter fence. Yet, immediate notification of all activations is required to allow the alarm monitor to determine appropriate response actions. Once an alarm activation occurs, the sensor system must also be capable of continuing to monitor the intruder's position until the responding force arrives.[3]

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[3]Security Police Directorate, Resources Branch, Headquarters USAF, "A Planning Guide for the Application of Ground Sensors to Physical Security and Air Base Defense," 16 March 1973, p. 4. Files of the Directorate, Forrestal Building, Washington, D. C.

Analysis of present sensing devices has shown that no system can provide 100 percent detection capability. Each system has inherent limitations and proficiency is subject to some design and environmental controls. In most situations where sensors are deployed, redundant coverage will be necessary to insure that acceptable limits of surveillance and detection are maintained. Redundant coverage provides the user with two advantages over a single sensor line of defense.[4] First, redundancy provides an increased probability of detection. If a microwave intrusion detector with a probability of detection of 90 percent is used in a room, then there is a 90 percent probability of detecting an intruder. However, if a passive infrared detector, also with a 90 percent detection probability, is coupled with the microwave unit, the overall probability of detection jumps to 99 percent. Second, with redundancy, if one unit should become inoperative, a partial capability of detection -- in this instance, 90 percent -- still exists. The high value resources protected by the security police in most instances require redundancy in the placement of electronic sensors.

The use of deadly force is authorized in defense of

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[4]S. P. Directorate, ". . .Physical Security and Air Base Defense," p. 12.

nuclear weapons and related high priority national defense resources. Under peacetime conditions, the decision to employ deadly force against a hostile intruder is left to the judgment and discretion of the individual policeman. Under general war conditions, or when the perceived threat analysis is highly serious, the Air Force must have the capability in select areas to install automatic, punitive sensing devices. Development and storage of such devices should be accomplished for immediate deployment should the necessity arise.

Installation and maintenance of electronic sensing devices must be kept as simple as each individual design situation allows.[5] Electronic sensors employed by the Air Force will be operated almost continuously and under the widest possible environmental conditions. This will place great stress on the equipment and the need for systems that can be easily maintained. Where possible, maintenance and repair should be geared to base level technicians. As the larger security units are equipped with greater varieties and numbers of devices, the assignment of repair technicians to the security unit will offer a substantial improvement to the overall security system. The on-base presence of technicians

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[5]The remaining general system requirements were suggested by Chleboun and Duvall, . . .Alarm Systems, pp. 5-12 - 5-19.

knowledgable of the devices becomes even more important in tactical organizations that may be rapidly deployed to any "hot spot" in the world.

Ease of operation must also be included in the design of the sensing equipment. In order for the security police to have confidence in the system they must be capable of utilizing the devices at optimum levels of operation and with a full understanding of each device's capabilities and limitations. They must be familiar enough with the equipment that they can operate it under the most trying of wartime conditions.

Operator confidence in the sensor system is also contingent upon the reliability and efficiency of the sensors. False alarm rates must be kept as low as is operationally possible, yet the presence of intruders must not go undetected. The system must also be invulnerable to defeat by intruders or through minor accidental damage to the devices. Finally, electronic sensors employed in support of the security police mission must be designed so as not to pose a safety hazard, as in the case of the devices utilizing microwaves, or those which would adversely affect the operation of other electronic devices on the installation.

In summary, the Air Force requires electronic sensing

devices with the designed flexibility to be efficient in both war and peacetime and in a variety of environmental and geographical settings. Costs must be held to the absolute minimum, consistent with the requirements of the security planners. Modular and interchangeable construction is required to support the unique and changing security mission. The sensing devices must provide real time notification and be capable of continuous surveillance once an activation occurs. Selected devices must have the potential of punitive performance. Redundancy is an essential requirement as is the necessity of convenient installation, repair, maintenance and operation. Additionally, the devices must be highly reliable, safe, and compatible with other adjacent electronic equipment.

CHAPTER THREE

ELECTRONIC SENSORS PROGRAMED FOR AIR FORCE UTILIZATION

Introduction

The Air Force has traditionally utilized door contact switches to detect the opening of nuclear storage building doors.[1] These devices have also been utilized on hardened missile sites and aircraft alert shelters. It was not until the U. S. Army began using ground sensors in the Vietnam conflict, however, that the full benefit of an expanded sensor program was realized. The increased security threat to the nation's nuclear resources has led to a Department of Defense commitment to the use of sensors as an essential part of the nation's physical security system. The Air Force has recently become a strong advocate of electronic security for reasons of the acknowledged inefficiency of the human sentry as well as for the increased threat to its resources.

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[1]Security Police Directorate, Resources Branch, Headquarters USAF, "A Planning Guide for the Application of Ground Sensors to Physical Security and Air Base Defense," 16 March 1973, p. 1. Files of the Directorate, Forrestal Building, Washington, D.C.

Air Force Base and Installation Security System

In October 1973, the Department of Defense directed the establishment of an inter-service sensor development program.[2] The directive tasked the Army with the development of all interior security sensors and tactical remote sensor systems. The Navy was directed to improve upon the present generation tactical remote sensors. All exterior sensor systems designed for base and installation use were assigned to the Air Force.

The Air Force, as the single service manager for exterior base sensor systems, assigned the project to its Air Force Systems Command.[3] Under Systems Command, a "Base and Installation Security System" (BISS) office was established. The BISS office will direct the entire project, from research through development, testing and evaluation. In this section, devices in use or programed for future development will

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[2]U. S., Department of the Navy, Office of the Chief of Naval Operations, "Army-Navy-Air Force-Marine Corps Agreement for Coordination of Tactical Remote and Physical Security Sensor Systems Development," 24 October 1973. Files of the Security Police Directorate, Resources Branch, Headquarters USAF, Forrestal Building, Washington, D.C.

[3]Security Police Directorate, Resources Branch, Headquarters USAF, "Security Police Briefing to the Air Force Council," March 1974. Files of the Directorate, Forrestal Building, Washington, D.C.

be described according to their specific function as they were in Part Two, Chapter One. Devices currently in use were developed prior to the BISS program but are described here as if they were part of the BISS program.

Access Control

Security devices for access control are still in the conceptual stage. The BISS office is designing the system to provide elements of both control and identification.[4] Control equipment will be designed around a double gate to prevent unauthorized forced entry into the restricted area and to prevent escape should an intruder fail to be admitted through the identification process. Similar controls will be utilized at vehicle entrance points. Identification elements are planned to include personal identifiers such as finger prints or voice prints. The Air Force is also considering the use of coded access cards. Closed circuit television is currently planned for use at access control points. The control monitor will be placed in a central location and will operate the gates from that position. BISS access control

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[4]Security Police Directorate, Resources Branch, Headquarters USAF, "System Concept for Base and Installation Security System," 7 May 1973, pp. 12-13. Files of the Security Police Directorate, Forrestal Building, Washington, D.C.

concepts appear compatible with the state of electronic security technology, although it does not appear that the benefits of the handprint personal identifier have been considered. BISS endorsement of the use of the coded access card also does not appear to be in the best interest of security, because the card is subject to compromise as was discussed earlier. The use of closed circuit television appears essential for adequate security at access control points. A device to allow communication between the controller and personnel desiring entrance to the restricted area would be a valuable supplement to the television system.

Point Sensors

As previously stated in the introduction to this chapter, the Air Force has historically utilized the magnetic door switch. Few problems have been encountered with the device, and once interior intruder sensors are developed by the Army, adequate security will be provided those resources which are secured in hardened structures. The parked aircraft capacitance sensor system described in Part Two, Chapter One, has been acquired by the Air Force.[5] The system has proven to be

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[5]S. P. Directorate, ". . . Physical Security and Air Base Defense," chapter II, pp. 7-8.

reliable, and it detects personnel approaching within a few feet of the alarmed aircraft. False alarming has not been a problem with the system except in high winds above thirty-five knots, and during severe electrical storms. From a technological standpoint, the Air Force has utilized the most efficient point sensor available.

Area and Perimeter Sensors

To this date, action has been limited to the development of perimeter sensors. The Air Force believes that area surveillance devices, such as closed circuit television and infrared beam breakers, while necessary in a total security system, are less essential than a fully operative perimeter system. Funds are now being allocated for securing the outer ring of protected areas under the rationale that nuclear storage structures and alert aircraft are sufficiently secured for the present and that the detection of intruders at the most distant perimeter the protected area is of first importance.

Several different types of perimeter sensing devices have been developed and installed.[6] A buried, combined pressure-ferrous metal detector that is strung along a perimeter

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[6]S. P. Directorate, ". . .Physical Security and Air Base Defense," pp. 1-7.

has recently been installed at numerous bases. The range of protection is normally from one to two meters on each side of the sensor line. Redundancy is provided by combining pressure and magnetic caused activations into the same sensor. The liquid-filled hose sensor described under pressure sensors in Part Two, Chapter One, has also been employed by the Air Force. The devices are being emplaced, either manually or mechanically, in continuous, one hundred meter increments. Adequate performance has been achieved, although it has been found that frozen ground seriously degrades the system.

Seismic sensors have also been developed which utilize one internal and four external geophones. The device offers protection up to one hundred linear meters. Rearrangement of the geophones can enable the device to serve as point sensor. Electro-magnetic intrusion detectors utilized by the Air Force have had limited success, primarily as a result of their susceptibility to false alarming caused by birds, animals and moving foliage. Finally, the mercury switch pressure sensor previously described has been installed on perimeter fences. The primary limitation has been that wind gusts as low as ten knots have plagued the device with false alarms.

Sensors capable of activating a punitive device such as tear gas or pop-up mines will interface with BISS

equipment.[7] The devices will be designed either to deter, disable, or destroy intruders in extremely high threat areas. Non-punitive security aids such as sensor activated flares and local alarms are also being designed.

The development and selection of perimeter sensors operating on a variety of principles is essential to the Air Force's worldwide mission. The failure to include the proximity capacitance fence sensor, however, is a serious limitation on its perimeter sensor arsenal. Its performance is superior to the current fence sensor, and its installation and maintenance would be less costly. Finally, to have a complete surveillance capability, the addition of a closed circuit television system with a low light level capability is required for both area and perimeter surveillance.

Internal Intruder Sensors

The Army has been tasked with the development of all internal intruder sensors. It is developing a variety of different sensor systems in order to maintain the required flexibility of worldwide deployment. To this date, the Army has limited development to the ultrasonic motion detector and to the passive acoustic sensor which activates an alarm

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[7] S. P. Director, "...Base and Installation Security System," pp. 13-14.

when noise results from attempts to penetrate a structure.[8] Although the ultrasonic detector is effective, its limitations (discussed in Part Two, Chapter One) require the presence of a redundant system operating on a different electronic principle. The passive infrared sensor is an effective device which is compatible with the ultrasonic unit, and should be considered as an improvement over the placement of a single ultrasonic sensor. It is essential that the Air Force work closely with the Army to insure its requirements are known and that the Army developed sensors are compatible with Air Force receivers and annunciators.

Sensor Data Transmission

The BISS program will utilize both hardwire and radio frequency transmissions to carry signals from the various sensors to the control unit.[9] The hardwire transmission will be preferred over radio frequency, due to the vulnerability of the latter system to monitoring, jamming, and false activations. Where multiple sensors are linked together, as in linear perimeter systems, multiplexed transmission lines will

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[8]Defense Special Projects Group,"Joint Service Interior Intrusion Detection System: Equipment Application Guide," Naval Observatory, Building 56, Washington, D.C., pp. 11-15.

[9]S. P. Directorate, ". . .Base and Installation Security System," p. 7.

be used. This allows the various sensor signals to be carried over a single transmission line, yet be broken down at the control center to allow independent visual display of the specific sensor which is alarming. The back-up radio frequency will be used to provide the flexibility necessary for the tactical deployment of sensors under less than optimum conditions.

Sensor Monitors

Sensor monitoring devices, under the BISS project, will provide both visual and audible alarms when intruders are detected or when the system is tempered with or malfunctions.[10] Display panels will be designed to operate in both non-environmentally protected, mobile field conditions and in permanent, indoor stations. Individual activations will be displayed on a geographical map showing the actual sensor which is alarming. A separate display will show the status of each alarm; i.e., alarms which are either set-up, activating, being tampered with, malfunctioning, or shut off to grant authorized access. Optionally, a hard copy printer will be available where desired, to provide a record of activations, sensor identification, status tests, and malfunc-

[10]S. P. Directorate, ". . . Base and Installation Security System," pp. 9-15.

tions. Closed circuit television monitors, access control switches for doors and exterior lighting, and elements used in verifying personal identifiers at access control points will also be located in the control center. Monitor-display units for electronic sensors developed prior to the BISS program will be phased out and replaced as the new generation sensing devices are procured. The new monitors will be designed to allow interfacing with third generation equipment as it becomes available.

To summarize, the Air Force has only recently established a centralized program to develop electronic sensors to replace the ineffective human sentry. Initial efforts have been limited to the development and placement of perimeter sensors. When the project has been completed, sensors will replace sentries presently assigned as access controllers, point guards, and perimeter and area sentries. A variety of electronic equipment will be developed to fit the unique security requirements of each installation.

Manpower and Cost Savings

The introduction of electronic sensing devices into the Air Force's physical security system will change the role of the security policeman from passive surveillance and

detection to a role of responding to and resolving alarm situations. The elimination of the surveillance task will result in significant manpower reductions. The Air Force believes the cost of the electronic equipment will rapidly be amortized through the manpower savings.[11] Although manpower and cost savings have not yet been figured for the completed BISS program, the figures for savings based on the currently emplaced perimeter sensors are significant. By 1979, 1,203 sentries will be eliminated at a savings of over seventeen million dollars, with an annual savings of over ten million dollars thereafter. These figures are based only on the removal of sentries where perimeter and aircraft point sensors will be employed. These manpower savings are somewhat tentative because they were developed before additional sentry positions were added to security police squadrons, necessitated by the increased terrorist threat that has recently evolved. However, without the addition of perimeter and aircraft point sensors the "terrorist" manning figures would have had to be significantly increased.

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[11]Security Police Directorate, Resources Branch, Headquarters USAF, to Director of Security Police, Strategic Air Command, "Program Objective Memorandum Exercise," 24 May 1973, filed at Security Police Directorate, Resources Branch, Forrestal Building, Washington, D.C.

The manpower savings are based only on the salary costs that will be eliminated as the sentries are phased out. Additional savings will result from the costs that would have been associated with the support, equipping and training of the sentries. Significant savings will also result from the elimination of money spent in resolving the disciplinary problems associated with airmen performing sentry duty. For instance, during fiscal year 1974, the Air Force lost just under seventeen million dollars caused by the retraining and early release from active duty of non-productive security policemen and by the procurement costs of providing replacements.[12]

The replacement of the human sentry with electronic sensing devices will not only alleviate a significant personnel management problem, but will also result in an increased security posture at less overall cost. The movement of the Air Force toward a fully integrated security system combining human and electronic resources appears to be fully justified.

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[12]Security Police Directorate, Resources Branch, Headquarters USAF, to the Director of Personnel, Headquarters USAF, "Program Budget Decision Reclama," 4 December 1974, filed at Security Police Directorate, Forrestal Building, Washington, D.C.

PART THREE

PROPOSED PHYSICAL SECURITY MODEL

CHAPTER ONE

MODEL PHYSICAL SECURITY SYSTEM

Introduction

The selection of electronic sensing devices to provide the detection function of the physical security system will be dependent upon a number of considerations. First, the threat analysis must be considered in order to insure that the resources are neither over- nor under-protected. The threat analysis should include general considerations of the military and political climate and specific consideration of the vulnerabilities of the individual resources to be protected. Sensors should also be selected with consideration of the particular geography and environment in which the sensors are to be placed. Sensors should be selected which have high reliability and which have low false alarm rates due to the preselection consideration of the area in which they are placed. Finally, sensing devices should be selected that are modular in design in order that they may be adaptable to a variety of uses and interchangeable with other components.

This chapter describes a model physical security

system in which detection function is fully performed by electronic sensing devices. The following chapter discusses the support requirements of the model system. It concludes with a summation of the ideas presented in this paper and suggests further research applicable to physical security systems.

Deployment and Utilization of Sensors

Under the model physical security system, electronic sensing devices are utilized in a variety of areas where the detection of intruders is required. They should be used at designated entry control points, the nuclear storage area, aircraft alert and mass parking areas, and at missile sites.

The security system will operate on a decentralized concept. Management of the entire security operation will center at the geographically separated central security control. Central security control will contain redundant displays of all the decentralized sector control centers, and will maintain the capability of operating any sector control center in the event it becomes inoperative. It will also house a back-up security force capable of response to any sector.

An on-line computer should be located at the central security control which should be shared by the sector control

centers. The computer should be linked with the access control electronic devices and each sector sensor. All access and exit transactions should be recorded on a machine print-out to include the name of the individual, the area visited, and the times of the individual's arrival and departure. Access authorizations for each individual should be stored in the computer's memory bank. Similarly, all alarm activations should be specified on the print-out showing the specific alarm, the time of the activation, and the cause of the activation, i.e., intrusion, tampering, or malfunction. Finally, the computer should print changes to the current status of each alarm, i.e., secure, deactivated, or deactivated to grant access.

Under the concept of the decentralized security system, each major protected area should contain a sector control center. Separate sector control centers should be responsible for the security of the aircraft alert area, mass parking area, nuclear weapon storage area, and the missile site. The sector control center should contain geographical map displays of all sensors in the sector, alarm panels for the sensors and closed circuit television receivers. Intercoms should be provided for communication with the sector's access control points. Radios and telephones should allow

communication with the entire security force. Different radio frequencies should be assigned each sector, with one common emergency frequency available to all radio transceivers. Each sector control center and response force should be located within its own area of protection, with the exception of the center for the mass parking area. In this instance the building housing the sector control center and the response should be located immediately adjacent to the area but off the parking ramp so as not to interfere with taxiing aircraft. Mass parking areas contain stand-by aircraft that may be immediately up-loaded with weapons and flown to target areas upon receipt of a deployment message. They must be secured in order to insure their quick reaction, war-making capability.

Entry Control Facilities

The sector control monitor should act as a centralized entry controller for his sector. He should be aided by different electronic devices according to the particular needs of each protected area.

Access within the nuclear weapons storage area is controlled at two points by the storage area sector control monitor. Initially, personnel desiring entrance to this area should ring a buzzer at the external entrance gate. The

buzzer should annunciate at the sector control center. The control monitor should activate a closed circuit television monitor, visually check the visitor and electrically open the exterior door. Once inside the exterior door, the visitor must be approved by a personal identifier, either finger or handprint, before the second, interior door is unlocked. Personnel leaving the area are out-processed in a similar manner through adjacent doors. A vehicle access point should operate in much the same manner. All passengers should be processed through the personnel entrance doors. The driver of the vehicle should ring a buzzer outside the exterior gate, and be permitted to drive to the second gate once the control monitor activates the closed circuit television. Once secure between the two gates, the driver should open all doors to the vehicle and the trunk lid, if applicable, to allow television monitoring, and identify himself via a personal identifier in the enclosed area. Once authorized final access, he should drive through the opened interior gate where his cleared passengers will join him.

The control process under the model system is clearly more time consuming than that of the totally human controlled process. It may be required that a sentry be posted at the access point during peak traffic periods and during general

alerts when large masses of men must pass through the doors. During these periods, it may be necessary to leave the doors open, although personnel will still be granted access through verification by the personal identifier.

Access to individual nuclear weapon storage bunkers should also be controlled by the personal identifier. The Air Force requires a minimum of two qualified personnel to be present at all times when working around nuclear weapons. In this case the personal identifier should be programed to reject an exemplar if a second authorized person does not identify himself within thirty seconds of the first individual's identifying act. Under the model system nuclear weapon technicians will approach the bunker they wish to enter. They should contact the sector control monitor via intercom, and then a minimum of two authorized personnel should perform the personal identifying task. Upon authorization by the computer's memory bank in central security control, an "authorized" lamp will light on the sector control monitor's visual display board. He should then switch the various sensors in the bunker to access and the technicians should open and enter the bunker. Upon departing, the process should be reversed in order to maintain a print-out record of the entire transaction.

Entrance into the alert aircraft area should be accomplished in the same manner as was entrance into the nuclear weapons storage area, with the one difference that the control monitor should be in the alert aircraft area sector. Access should be granted to a specific aircraft by a process whereby the designated aircraft commander and one other crew member present themselves to the sector control monitor. He should verify their authority by an access roster and then monitor their approach to the aircraft by closed circuit television. Once the crew is at the aircraft he should put the aircraft's sensor system on access and the crew should be allowed to enter the aircraft. The sensor control monitor should reset the closed circuit television once the crew is in the aircraft. When the crew leaves the aircraft, the closed circuit television will detect their presence and alarm. The sector control monitor should then reset the aircraft sensor system and monitor the crew as they return to the alert building. The same procedures are applicable at missile sites.

Access procedures for the mass parking area will again differ from the previously discussed areas. Individual aircraft in the mass parking area will not be protected by point sensors. Security will be limited to perimeter and area sensing devices. Personnel desiring access to the area should

report to the sector control monitor, located adjacent to the area. The control monitor should speak to the personnel desiring access via an intercom as they stand before him on the outside of a hardened window. Access should be granted via an externally placed personal identifier. Once authorized, the control monitor should momentarily place the perimeter sensor on access as the visitors step into the area. Once the visitors are inside the protected area, he should again set up the perimeter sensors. At the same time, he should place the closed circuit television area sensor on access. Once the visitors (authorized personnel) are in the aircraft, he should reset the closed circuit television. This should cause the television system to alarm when the visitors leave the aircraft. He should then monitor the visitors via television until they leave the area, reversing their entrance procedures. During mass loading of the aircraft, the television system should be placed on access (continuous monitoring) and members of the response force should be in the area as posted sentries.

Entry into Central Security Control, the installation command post, and the mass parking area sector control center should also be granted by the personal identifier. The mass parking area sector control center requires special access

procedures, whereas the other sector control centers do not, because it is not otherwise protected by perimeter and area sensors. Access should be monitored at these three locations by personnel within the rooms. A double door should be utilized, but one-way, hardened windows should be utilized in lieu of the closed circuit television. The personal identifiers should be located between the two doors and should be utilized upon entering and exiting, for purposes of authentication upon entering, and to record both the coming and going of the personnel.

Frequently, personnel who have not been granted entry approval will require access to the protected areas. In order to handle such occasions, escort officials should be designated, and their status stored in the computer memory bank. On such occasions, the escort official should notify the sector control monitor that he is escorting non-authorized guests. The control monitor should notify central security control, who should look for the print-out verification of the individual's escort privileges when he uses the personal identifier. Once access has been granted, the sector control monitor should forward the names of the guests to central security control. The names should then be typed into the computer and appear on the computer print-out record.

The escort official must be in the presence of the guests at all times and they must depart with him. Current computer print-outs of authorized and escort personnel should be available at all times for use by human controllers in the event one or more of the personal identifiers should malfunction.

Point Sensors

Point sensors should be utilized on the doors to nuclear weapon storage bunkers, hardened missile launch sites and, when used, alert aircraft hangars. They should also be utilized on alert aircraft and transitory aircraft used to ferry nuclear weapons. Doors should be equipped with the magnetic door switch and individual aircraft should be protected by a capacitance sensor system. Each alarm should terminate at the applicable sector control center. These sensors should be activated at all times except when the control monitor has granted access to the specific area. The sensors should be activated, deactivated, and put on access at the control monitor station. Backup support for the systems should be provided by redundant coverage through other sensors. Structures should have redundancy via interior area sensors and aircraft should have redundancy provided by area and perimeter sensing devices.

Interior Area Sensors

Nuclear weapon storage bunkers and hardened missile structures may be protected by a variety of sensing devices. Selection of the appropriate devices should be based on an evaluation of external factors which could cause false alarming or malfunctions. Redundancy should be employed to reduce this possibility. Any two of the following sensors should be used, depending upon the pre-installation evaluation: ultrasonic intrusion sensors, microwave sensors, passive infrared sensors, passive acoustic sensors and radar-doppler systems. The interior area sensors from each protected room should be tied in with the computer at the central security control center. The computer should only cause an activation at the alarm panel if both sensors activate. This should preclude a false activation of one sensor from annunciating at the control center. Tampering with or malfunctions of one sensor, however, should be announced to the sensor control monitor. The interior sensors should annunciate and be controlled by the sector sensor monitor.

Area Sensors

Area sensors should be utilized in alert aircraft parking areas, mass parking areas, nuclear weapons storage areas, and missile site operational areas. In most instances,

it should not be necessary to protect the entire area. Sensor coverage should normally be required only in the immediate area of the protected resources to provide surveillance over approaches to these positions. Closed circuit television transmitters with low light level capabilities should serve as the primary area sensor. The system should operate in conjunction with the computer at central security control. The computer should cause an audible alarm to ring and the receiver to activate when it detects the presence of an intruder moving in front of the camera. Perimeter sensors immediately around the area protected by television cameras should also be linked to the computer, which should activate the closed circuit television system should they detect an intruder. Automatic monitoring and activation of the television system is essential in order to preclude the controller from having to monitor the receiver continuously. Small areas which may offer concealment from the television monitors should be covered by one of several different types of sensors, such as vibration detectors, photoelectric beam breakers, radar sensors, and magnetic or pressure sensors. Selection of the supporting sensor should be based on the device which has the lowest false alarm rate when placed at that specific location. These devices should also be routed

through the computer to activate the closed circuit television system. The sector control monitor should activate and deactivate the support sensors from his position.

Perimeter Sensors

Perimeter sensors should be utilized around the aircraft alert area, mass parking area, nuclear storage site area and the missile site. All areas except the mass parking area should also be protected by two adjacent chain-link security fences. The exterior fences should be protected by either a proximity capacitance sensor, a vibration detector, or one of the pressure sensors. Where operational considerations allow, the capacitance sensor should be preferred, due to its low false activation rate and its ability to detect tunneling activity under the fence.

The mass parking area is normally established on the regular flightline parking ramp. As such, security fencing cannot be employed. Perimeter security in this area may be obtained by the use of photoelectric beam breakers, radar sensors, or laser beams. Approaches to perimeter sensors that may afford an intruder concealment should be protected with appropriate sensing devices, as were locations within the perimeter. As these devices will be out of the range of the closed circuit television system, there should be no need

to route their activations through the computer to activate the television system. Activations of sensors placed on the exterior of the perimeter fence should be investigated by the sector response force. Sufficient redundancy of perimeter and area sensors can support malfunctioning of one of the systems for short periods of time without serious degradation of security. When malfunctions occur during periods of high security threat, members of the response force may be required to assume sentry positions until the sensor system is again operating. A high security threat may also require the placement of punitive devices in conjunction with sensing devices. Devices such as tear gas and pop-up mines will be placed within the viewing range of closed circuit television transmitters. The sensor control monitor should verify the presence of a potentially hostile intruder before activating the punitive device from his location.

Mobile Security Systems

Mobile physical security systems should be available for individual aircraft transporting high value cargo and for aircraft deployed under contingency conditions to airfields and landing strips where security facilities are minimal or nonexistent. The mobile security devices should have the capability of immediate emplacement, all-weather operation,

and annunciators and display maps that will operate under field conditions. Devices suitable for deployment due to their simplicity of design and ease of placement, include vibration sensors, photoelectric beam breakers, magnetic detectors and pressure sensors. The use of radio frequency sensor alarm transmitters should preclude the necessity of stringing hardwire lines. Similarly rechargable battery packs for the sensors should eliminate the placement of electrical lines. If the aircraft remain at the deployed site for an extended period of time, more permanent and redundant sensing devices may be added to the initial security system. The success of a deployable security system depends upon the ability to interface the various possible components with the annunciators and display panels. This capability must be a prerequisite in the development of the mobile system.

Conclusion

It is technologically possible to utilize sensing devices to perform the detection function in physical security systems. The development of such a system, however, is not a "security utopia." Machines malfunction, wear out, and perform improperly when incorrectly used. The basis of any security system must be the human operator. Central monitors must fully understand the strengths and weaknesses of each

component. Finally, the success of the security mission will rest with the response force. It must be constantly on the alert, correctly deployed, and sufficiently trained to make the appropriate response upon the activation of a sensor. In the following chapter, the support requirement that will make or break the model security system will be discussed.

CHAPTER TWO

SUPPORT REQUIREMENTS FOR THE MODEL PHYSICAL SECURITY SYSTEM

Introduction

In Part One, the present quality of Air Force screening procedures for personnel entering the security police career field and the supervisor to worker ratios were criticized. Success of the proposed model security system depends upon the correction of these management deficiencies. Although the more negative of the security police tasks will be eliminated by the use of electronic sensing devices, the new system will still require a professional security police force. Operation of the security equipment will be significantly more complicated than under the old system. Supervisors and security policemen alike will have to adjust to and provide constructive use of the leisure time of the men waiting in the response force alert room. Also, security planning must be an on-going process to maintain optimum effectiveness of the security program.

Personnel Requirements

Input

Personnel selected for entrance into the security police career field should be screened prior to entrance into technical training programs. The screening should include psychological and aptitude screening, based upon prior determinations of favorable qualities found in security policemen who have satisfactorily adjusted to the security police career field. Volunteers should be sought for the career field and should only be accepted after they have been completely informed on the nature of the job. Entrance requirements should prohibit the acceptance of personnel into the career field who have any history of drug or alcohol abuse.

Supervision

An effective supervisor to worker ratio should be established for each security police squadron. Specific ratios should be determined for each squadron based upon the requirements of the particular installation. Operational supervision should include an officer on duty as the flight commander at all times. In small units, overall flight supervision should be assigned to noncommissioned officers in the rank of E-7 (Master Sergeant) or higher. A senior noncommis-

sioned officer should be present in the central security control at all times. The presence of a middle-grade noncommissioned officer should be required at all times in each sector control center. Response forces with more than three men should be under the direction of E-5 (Staff Sergeant).

Personnel Requirements

The specific number of personnel required to support the physical security system should depend upon the number and type of resources being protected, the geographical positions and size of the protected areas and resources, and the level of the security threat. Personnel should be assigned in one of three areas: supervision, control monitor, or response force. The positions of entry controller sentry, to include stationary, motor, and walking posts, and canine patrols, should be eliminated. When entry controllers and sentries are required due to sensor malfunctions, they should be drawn from the response force.

Response Force

The response force should be located in the same buildings as the sector control centers. The back-up response force should be positioned at central security control. The passive nature of their preresponse activities will create management and morale problems unless the alert time is

constructively utilized. Management of alert time should include the scheduling of activities that will absorb the majority of the forces' free time. Security police training requirements should be provided during duty hours with the exception of weapons proficiency training. Separate areas in the response building should be available for recreational purposes and for on-duty educational pursuits.

With the exception of the response force supervisor, all response force members should be in their first enlistment. Efforts should be made to offer personnel who are interested in an Air Force career other than security police duty, on-duty training for other career fields which may be entered upon the completion of their initial enlistments. Personnel desiring to leave the service after their initial enlistment should be encouraged to pursue correspondence study of areas of their preference. In effect, all constructive uses of time should be encouraged in order to preclude the response force members from serving their eight-hour tours in idleness and boredom.

Duty Hours

Security police duty hours should not exceed 180 hours per month. Man-hour savings should be obtained from conducting training during duty hours, limiting guardmount time by

providing briefings while on post, and eliminating stand-by requirements by having sufficient personnel in the response force to handle security commitments. Shifts should be semi-permanent, with rotations occurring no more frequently than every ninety days.

Training

Initial training on the security aids should be integrated into the technical school curriculum provided to all security police entrants. Security police managers should receive indoctrination and familiarization on the equipment as well as the lower ranking airmen. Personnel selected for the positions of control monitors should receive hands-on training of all the equipment in the inventory. Refresher training on a recurring basis should be provided at the squadron level.

Maintenance of Electronic Equipment

Each installation having a physical security system employing electronic sensing devices should be staffed with personnel capable of maintaining and repairing the equipment. Equipment designed for the security system operates on electronic principles already utilized by the Air Force. The maintenance specialists for equipment now utilized which is

similar to the security devices should assume the responsibility for maintenance and repair of the related security equipment.

Maintenance personnel should be available at all times to handle equipment malfunctions. Preventive maintenance should be regularly scheduled as well as sensitivity adjustments for the sensing devices. Maintenance personnel should receive technical training on the equipment prior to assignment to installations where it is employed.

Conclusion

This paper has discussed the management problems and inherently poor detection capability associated with the security police sentry. A review of electronic sensing devices was made and it was suggested that electronic sensing devices can provide greater security through the detection of intruders than can a system dependent upon the human sentry. A review of the current Air Force sensor program was made, and future Air Force goals to improve their electronic security system were presented. The paper concluded with a proposed model security system combining human and electronic resources. The utilization of such a security system will greatly enhance the mission of the United States Air Force. The

system has applicability in the other branches of the military and in the civilian community.

Suggested Research

The recent improvements in electronic sensors applicable to physical security systems and their growing acceptance by the military and civilian communities necessitates further research in a variety of areas. Technical research is required to refine devices already in use and to develop new equipment utilizing the most recent developments in electronic technology. Efforts must be made to develop equipment with the highest sensitivity possible, coupled with the lowest possible false activation rates. Research in computer technology is also required in order to maximize its application to the security field. Development of computer-sensor systems that can discriminate the type of intrusion that is occurring is a fruitful area of research.

Research is also required in order to develop assessment criteria for the optimum selection of personnel suitable for security police duties. Research is also required to gain a better understanding of the over-involvement of security policemen in drug abuse, criminal behavior, and Human Reliability disqualification actions. Security police manage-

ment and supervisory practices should be analyzed and new procedures developed for the management of the combined human and electronic security system.

The actual effectiveness of the security policeman placed in a purely response role is not known. Research is required to better understand and manage this new security police role. The possibility of the new response role creating additional job boredom and dissatisfaction must be studied, from the perspectives of both the personnel performing this role and of those who must manage them. One possible method of increasing the status of the security police, improving job satisfaction, and providing for a better use of manpower would be to train selected security policemen in the maintenance and repair of the electronic equipment. Research into all aspects of this possibility would be profitable. It may be assumed that those who would attempt to gain illegal access to high priority Air Force resources protected by electronic security devices will not cease their efforts when they learn of the obstacles before them. The most determined will attempt to develop countermeasures that will allow them to bypass the security system. Research sponsored by the Air Force and the defense establishment must be directed to preclude this from occurring.

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