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Transportation Security Administration

Office of Security Technology

Airport Perimeter Security Projects for FY08-09

FINAL REPORT

Hagerstown Regional Airport (HGR)

Virtual Perimeter Monitoring System-Airport (VPMS-A)

U.S. Department of Homeland Security
Transportation Security Administration
Office of Security Technology
Advanced Surveillance Program
701 South 12th Street
Arlington, VA 20598-6016

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OVERVIEW

INTRODUCTION

In fiscal year (FY) 2006, the Transportation Security Administration (TSA) announced opportunities for general perimeter security enhancement projects at airports with typical configurations and existing barriers, such as fencing and concrete barricades. The announcement requested information from airport authorities on existing airport perimeter security vulnerabilities and proposals to mitigate those vulnerabilities through the inventive use of available technologies at intended perimeter access points (such as vehicle gates), perimeter boundaries, and terminals.

In FY 2008, TSA reissued the Airport Perimeter Security (APS) announcement to all airports, along with a second announcement addressing small to medium-sized airports with few or no barriers around their perimeters. The second announcement was for the Virtual Perimeter Monitoring System (VPMS) project intended to test a more elaborate solution that would better fit a smaller airport. The VPMS solution was developed by the Navy.

TSA requested airports provide white papers explaining the security deficiencies to be addressed and proposals, including technologies to be deployed and full life-cycle project cost estimates. 65 airports responded to the FY 2006 request and 35 airports responded to the FY 2008 requests. The airports proposed projects of varying complexity, from installation of a single piece of equipment to sophisticated, integrated systems.

Six airports were selected in FY 2006 to participate in the APS projects. In FY 2008 and 2009, TSA selected six additional airports for participation in APS and three airports for VPMS projects.

The attached report covers the test results of only one of the 15 total test sites. TSA plans to release each report singularly as the test results are completed and made available.

IMPLEMENTATION

Hagerstown Regional Airport (HGR) was selected to pilot the Virtual Perimeter Monitoring System-Airport (VPMS-A), a central command and control system developed by the Naval Surface Warfare Center – Panama City Division (NSWC-PCD). The deployment and operation of the new system would test different breach scenarios in order to generate information that would reflect the impact of the system on operational security (OpSec) awareness at HGR, as compared to that of the legacy system.

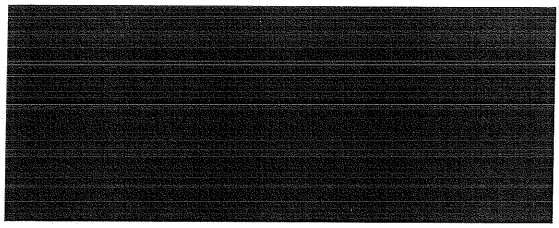
The VPMS-A surveillance system was designed to enhance OpSec awareness at HGR by interfacing with multiple technologies (sensor information or data streams) and displaying the information on a single Common Operating Picture (COP). The TSA, in cooperation with the

NSWC-PCD, piloted the system at several airports across the United States to evaluate its capabilities.

National Safe Skies Alliance (Safe Skies) provided independent verification and validation (IV&V) services and operated along with airport authorities to verify that the mobile perimeter tower enhancements met the airport's security expectations. The IV&V was concluded October 29, 2009.

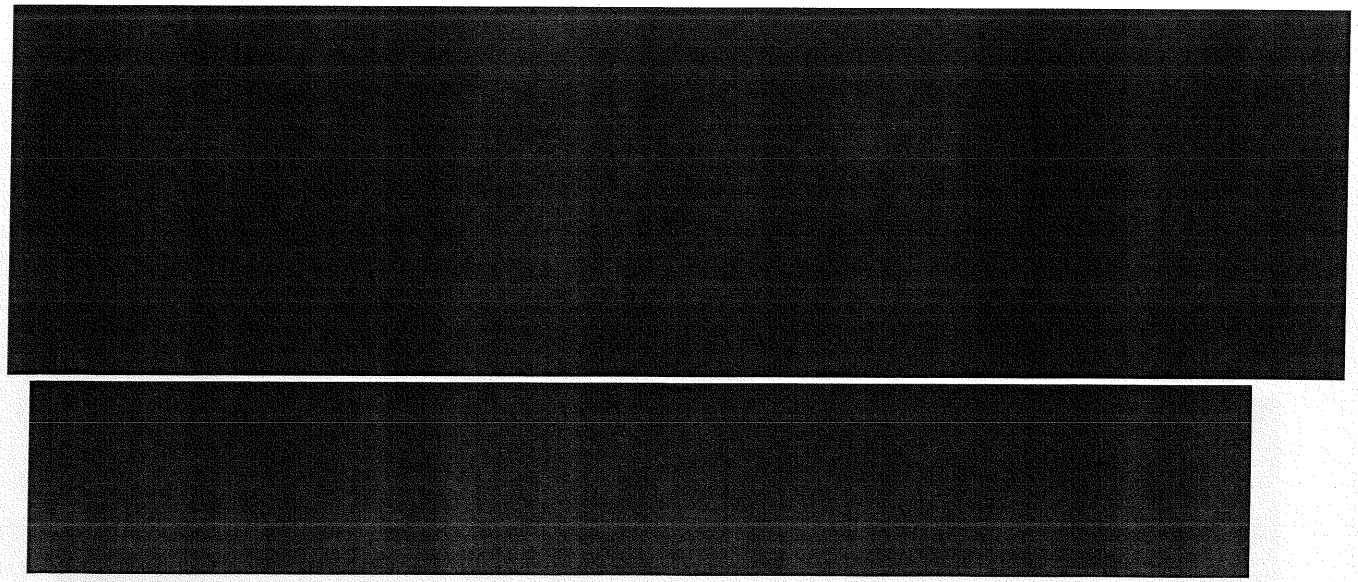
The VPMS-A system and equipment consisted of new video camera equipment (eight fixed cameras and eight Pan-Tilt-Zoom cameras), wireless communication systems, video analytic software, video archiving subsystems, and a Common Operating Picture (COP) platform.

The COP terminal and CCTV monitor were installed in the administration office, located in the airport Terminal; the Core server was installed in a separate storage area. Camera and communications equipment were installed at the following areas around the facility:



The Safe Skies Lead Test Engineer (LTE) generated a site survey document based on a preliminary survey of the locations prior to the deployment of the security technology improvements. The LTE developed operational testing procedures used as the basis for determining if the system met the security requirements of HGR airport authorities. Representatives of TSA, Safe Skies, and HGR convened to discuss and verify the system requirements prior to the implementation of evaluation procedures. The resulting operational data was analyzed by the Safe Skies statistical team and combined with the site survey information to generate the final report.

SUMMARY



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	Project Performed for: U.S. Dept. of Homeland Security Transportation Security Administration 601 S. 12th Street Mail Stop TSA-16 Arlington, VA 22209	TSA Technical Review Team Charles Kelley John Nestor David Taylor
	Project Funded by: Federal Aviation Administration 800 Independence Avenue, SW Washington, DC 20591	
	January 2010 Final Report	

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16. Supplementary Notes

This report was prepared by John Hunsucker of National Safe Skies Alliance.

17. Abstract

This report presents the evaluation results of the Virtual Perimeter Monitoring System – Airport (VPMS-A) as it was installed at HGR. VPMS-A was developed by the Naval Surface Warfare Center – Panama City Division to provide an adaptive system capable of enhancing operational security (OpSec) awareness at an airport perimeter. National Safe Skies Alliance, on behalf of the Transportation Security Administration, implemented a series of Operational Test and Evaluation scenarios in order to generate information that would reflect the impact of the VPMS-A on OpSec awareness at HGR, as compared to that of the legacy system.

Testing was conducted October 19 – 29, 2009, under mostly covert conditions, in order to test the system's performance capabilities in detecting intruders, suspicious behavior, and security protocol violations.

18. Key Words

Hagerstown Regional Airport, HGR, Naval Surface Warfare Center – Panama City Division, Virtual Perimeter Monitoring System, VPMS

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1.0	Final Draft/Charles Kelley	January 2010	

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[redacted]

LIST OF FIGURES

[redacted]

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EXECUTIVE SUMMARY

The Transportation Security Administration (TSA) selected Hagerstown Regional Airport (HGR) to pilot the Virtual Perimeter Monitoring System-Airport (VPMS-A), which is a central command and control system developed by the Naval Surface Warfare Center – Panama City Division. The intent of the pilot program was to demonstrate the utility of the system. National Safe Skies Alliance (Safe Skies) implemented a series of Operational Test and Evaluation (OT&E) scenarios in order to generate information that would reflect the impact of the VPMS-A on operational security (OpSec) awareness at HGR, as compared to that of the legacy system[1].

Legacy System Description

HGR's legacy security system had consisted of a CCTV network and video archiving system, [redacted]

Additional description of the legacy system can be found in Section 3.1 of this report.

VPMS-A System and Installation

The VPMS-A equipment—new video camera equipment (eight fixed cameras and eight PTZ cameras), wireless communication systems, video analytic software, video archiving subsystems, and a Common Operating Picture (COP)—were installed and operational in October 2009.

The COP terminal and CCTV monitor were installed in the administration office, located in the airport Terminal; the Core server was installed in a separate storage area. Camera and communications equipment were installed at the following areas around the facility:

[redacted]

[1] The *legacy system* was the perimeter security technologies that were present prior to installation of the VPMS-A.

[redacted]

[redacted]

Table 1 lists the equipment and location. Figure 1 illustrates the locations being monitored using video analytics.

Table 1. Technologies and Locations

[redacted]

Live feeds from eight fixed cameras sources were processed through the video analytic component, ObjectVideo. Through ObjectVideo, airport personnel set up customized rule sets that provided automated detection of violations. The PTZ cameras were installed and integrated into the system, but were not analyzed through the ObjectVideo software. Figure 2 illustrates the basic flow of information within the system.

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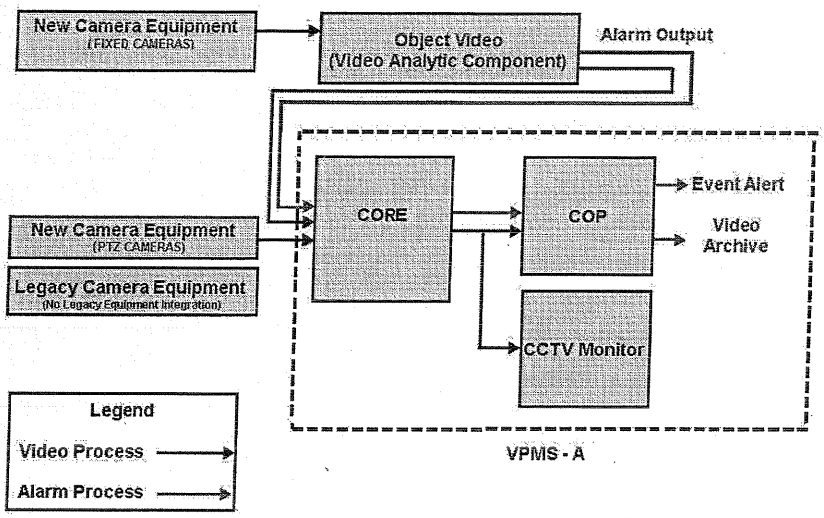

Figure 2. Block Diagram: Flow of Information Within VPMS-A

The VideoNEXT component, which reported the ObjectVideo detections, was accessible to security personnel through PCs both in the administrative security office and at the TSA station near the check-in counters. Through this software, security personnel could monitor alerts issued through the video analytic component and control the integrated PTZ cameras. The security office was also equipped with a large monitor that displayed all camera views – fixed and PTZ – simultaneously.

Additional details for the VPMS-A configuration can be found in Appendix A; further details of TSA and HGR requirements can be found in the following documents:

- *Draft System Segment Specification for the Hagerstown Regional-Richard A Henson Field Airport Virtual Perimeter Monitoring System*
- *Hagerstown Regional-Richard A Henson Field Airport Virtual Perimeter Monitoring System Operational Verification Test*
- *Hagerstown Regional-Richard A Henson Field Airport Virtual Perimeter Monitoring System Test Description*

User Surveys and Comments

Surveys were distributed to security personnel or those who were trained in its operation and had used both the legacy and VPMS-A systems. Only three surveys were returned: two from personnel with security background and training, and another from an office administrator. This was done in order to assess the users' opinions regarding the VPMS-A as compared to the legacy security system. [redacted]

[redacted]

[redacted]

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Evaluation Results

Safe Skies personnel performed covert evaluation scenarios throughout the VPMS-A coverage areas. Sites were limited to those that implemented video analytic rule sets: [redacted]

The primary objective of system testing and data collection was to address the following Critical Operational Issues (COI):

- COI 1: How effective is the VPMS-A COP at enabling situational awareness?
- COI 2: Within key location areas, how effective is the VPMS-A at HGR?

[redacted]

[redacted]

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Table 2. Site and Scenario Matrix

[redacted]

Between the time of the Baseline and the installation and calibration of the equipment and video analytic component, the areas of interest were modified. Accordingly, the evaluation team used the analytic software to determine the actual detection areas, and performed scenarios based on the rule sets defined there.

[redacted]

[redacted]

[redacted]

[redacted]

Section 5 of this report contains statistical evaluation of test scenario results and comparisons of OT&E to Baseline results obtained from the *Virtual Perimeter Monitoring System – Airport (VPMS-A) HGR Operational Baseline Test Report (DHS/TSA 2600.02.01.09-178*, July 2009*).*

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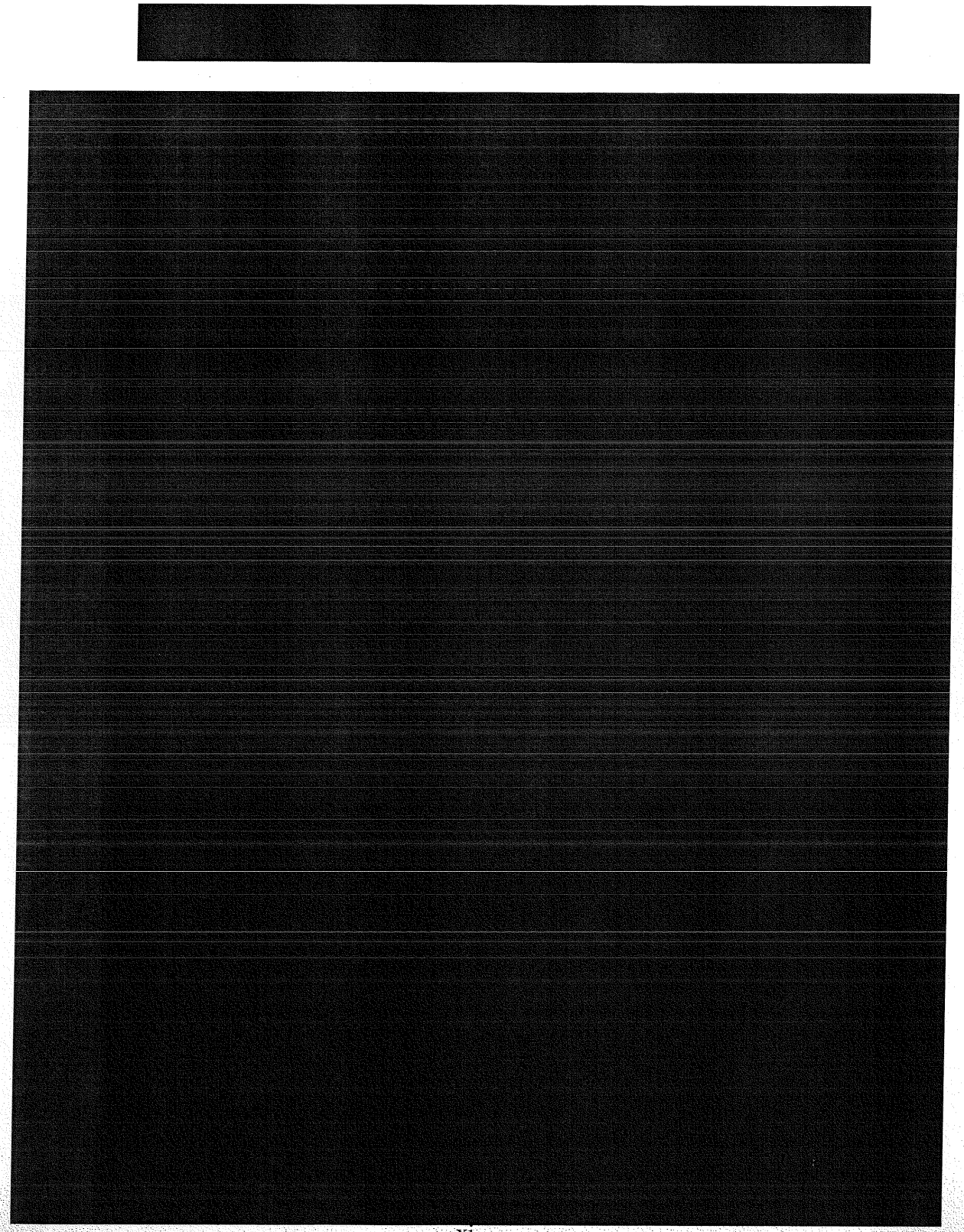

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Summary Observations

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ACRONYMS

CI	Confidence Interval
COI	Critical Operational Issue
COP	Common Operational Picture
FAA	Federal Aviation Administration
GA	General Aviation
HGR	Hagerstown Regional Airport – FAA designation
MOE	Measure of Effectiveness
MOP	Measure of Performance
NSWC - PCD	Naval Surface Warfare Center – Panama City Division
OpSec	Operational Security
OT&E	Operational Test and Evaluation
TSA	Transportation Security Administration
VPMS-A	Virtual Perimeter Monitoring System - Airport

[redacted]

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1. INTRODUCTION

The Transportation Security Administration (TSA) selected Hagerstown Regional Airport (HGR) to pilot the Virtual Perimeter Monitoring System-Airport (VPMS-A), a central command and control system developed by the Naval Surface Warfare Center – Panama City Division (NSWC-PCD). National Safe Skies Alliance (Safe Skies) implemented a series of Operational Test and Evaluation (OT&E) scenarios in order to generate information that would reflect the impact of the system on operational security (OpSec) awareness at HGR, as compared to that of the legacy system[4].

1.1 Background

The VPMS-A surveillance system was designed to enhance OpSec awareness at an airport by interfacing with multiple technologies (sensor information or data streams) and displaying the information on a single Common Operating Picture (COP). The TSA, in cooperation with the NSWC-PCD, piloted the system at several airports across the United States to evaluate its capabilities. Safe Skies was designated as the third-party evaluator to perform Baseline testing and OT&E.

1.2 Purpose of Document

This report details the scenarios and procedures that Safe Skies implemented in order to document the impact of the VPMS-A on OpSec awareness at HGR. The following sections describe the operational testing, and compare and contrast the operational evaluation data with results that were reported for the project Baseline (*DHS/TSA 2600.02.01.09-178*, July 2009).

2. SCOPE

Safe Skies evaluated the VPMS-A system at HGR in accordance with the Critical Operational Issue (COI) that was defined and approved in the project's Final Test Plan (*DHS/TSA 2600.02.01.09-155,* August 2009).

2.1 Limitations/Risks/Assumptions

The OT&E procedures and data collection activities were only performed at locations where VPMS-A equipment had been installed. This document does not reflect a security assessment for the entire facility.

The OT&E procedures were considered covert (i.e., general personnel on site were not to be aware of Safe Skies' agenda). There is no evidence to support that Safe Skies' agenda had been

[4] The *legacy system* was the perimeter security technology that was present prior to the installation of the VPMS-A.

[redacted]

[redacted]

compromised; thus, there is a reasonable assurance that the results accurately reflect the OpSec at HGR within and around the sites that were evaluated.

This document reports ObjectVideo performance and COP response. Because ObjectVideo is the detection component of the VPMS-A system, the tables that summarize the scenario detections were calculated using responses from the ObjectVideo system only. ObjectVideo results have been compared to Baseline results. Similar to OT&E testing, the Baseline tests were conducted covertly, but only six Baseline tests were conducted for each scenario and camera location. Safe Skies assumes that the Baseline results represent the OpSec response prior to the installation of VPMS-A.

[redacted]

3. SYSTEM DESCRIPTION

3.1 Legacy System

HGR's legacy security system had consisted of a CCTV network, video archiving system, and some activity-reporting technologies. The camera equipment, an array of 36 cameras, had been distributed throughout the Terminal apron, Fuel Farm, T-hangar, main parking areas, taxiways, vehicle gates, personnel gates, the general aviation (GA) areas, and the Federal Aviation Administration (FAA) Control Tower. The cameras were networked together via a fiber optic backbone and were channeled to a front-end video archiving system that consisted of 3 GE DVR units with 1- terabyte storage capacity.

[redacted]

[redacted]

[redacted]

[redacted]

The legacy access control system provided HGR security personnel with access logs and activity information for all badged employees and GA tenants who accessed the badge-controlled interior doors/portals or any of the exterior perimeter vehicle gates that were hardwired to the access control system.

The remaining elements of the legacy system were the personnel from the HGR Department of Public Safety, FAA Control Tower, GA, and civilians, who provided operational security awareness along the perimeter regions of the facility. These personnel were relied upon to support the areas of the perimeter that were not monitored by security technologies.

3.2 Virtual Perimeter Monitoring System-Airport (VPMS-A)

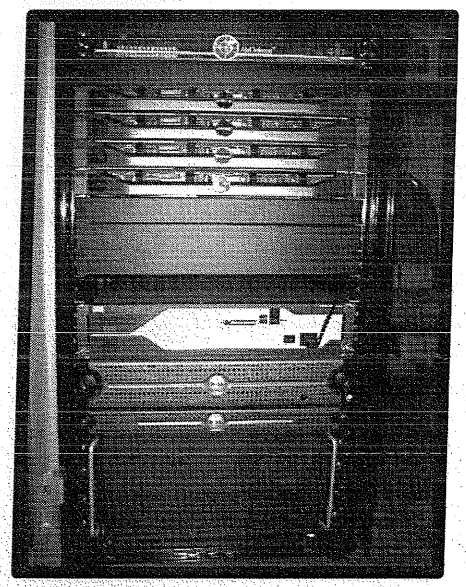


Figure 5. VPMS-A Core Server

The VPMS-A system included cameras with higher video quality camera equipment, wireless communication systems, video analytic software, video archiving subsystems, and a Common Operating Picture (COP). Designed to be an adaptive security tool, the VPMS-A's open architecture configuration allowed for the integration of multiple sensors or additional security equipment. Additional details of the VPMS-A configuration and system specifications can be found in the following NSWC-PCD documents:

- *Draft System Segment Specification for the Hagerstown Regional-Richard A Henson Field Airport Virtual Perimeter Monitoring System*
- *Hagerstown Regional-Richard A Henson Field Airport Virtual Perimeter Monitoring System Operational Verification Test*
- *Hagerstown Regional-Richard A Henson Field Airport Virtual Perimeter Monitoring System Test Description*

[redacted]

[redacted]

The core of the VPMS-A, shown in Figure 5, was installed and maintained in the HGR Terminal building. The core included the sensor interfacing, communications networking, sensor processing, the computer control and display equipment, and archive retrieval for the whole of the VPMS-A. Information was then streamed to the end-user interface in the control center.

At HGR, the control center was the main office in the Terminal, adjacent to the passenger screening lanes. Here, a single PC and set of peripheral devices drove the interaction between the end user and the surveillance network. This COP provided the end user with a means to view all of the integrated camera surveillance equipment, retrieve and display video archives, and review alarm alerts.

The following diagram (Figure 6) shows the flow of information within the VPMS-A from the sensor input through to the user interface components.

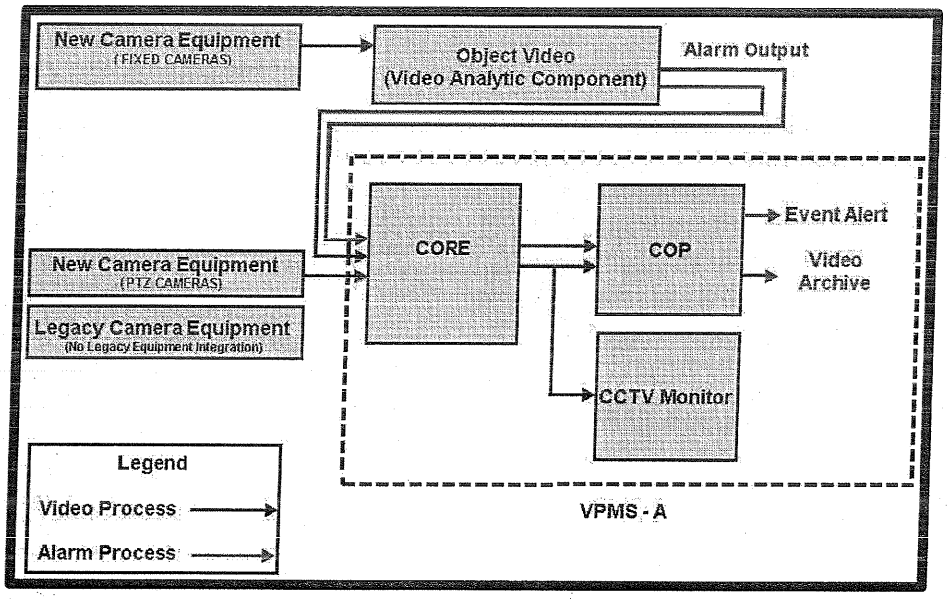


Figure 6. Flow of Information Within VPMS-A

As shown in the diagram, events performed within the view of the cameras were analyzed by ObjectVideo, the video analytic software. If ObjectVideo determined that the event constituted a violation of its rule-set configurations, it would issue alarms to VideoNEXT. This software was the user interface through which the ObjectVideo alarms were reported as "events" that security personnel could review and acknowledge as clear or requiring investigation. VideoNEXT also provided the controls for the PTZ cameras.

[redacted]

[redacted]

The VPMS-A equipment—new video camera equipment (eight fixed cameras and eight PTZ cameras), wireless communication systems, video analytic software, video archiving subsystems, and a Common Operating Picture (COP) — were installed and operational in October of 2009. Table 6 lists the camera type, quantity, and location for all VPMS-A camera equipment.

Table 6. Technologies and Locations

Camera Type	Locations
Fixed	[redacted]
PTZ	

The VPMS-A surveillance and communication equipment were installed in several locations throughout the HGR facility. As illustrated in Figure 7, below, cameras and wireless equipment were installed at:

[redacted]

[redacted]

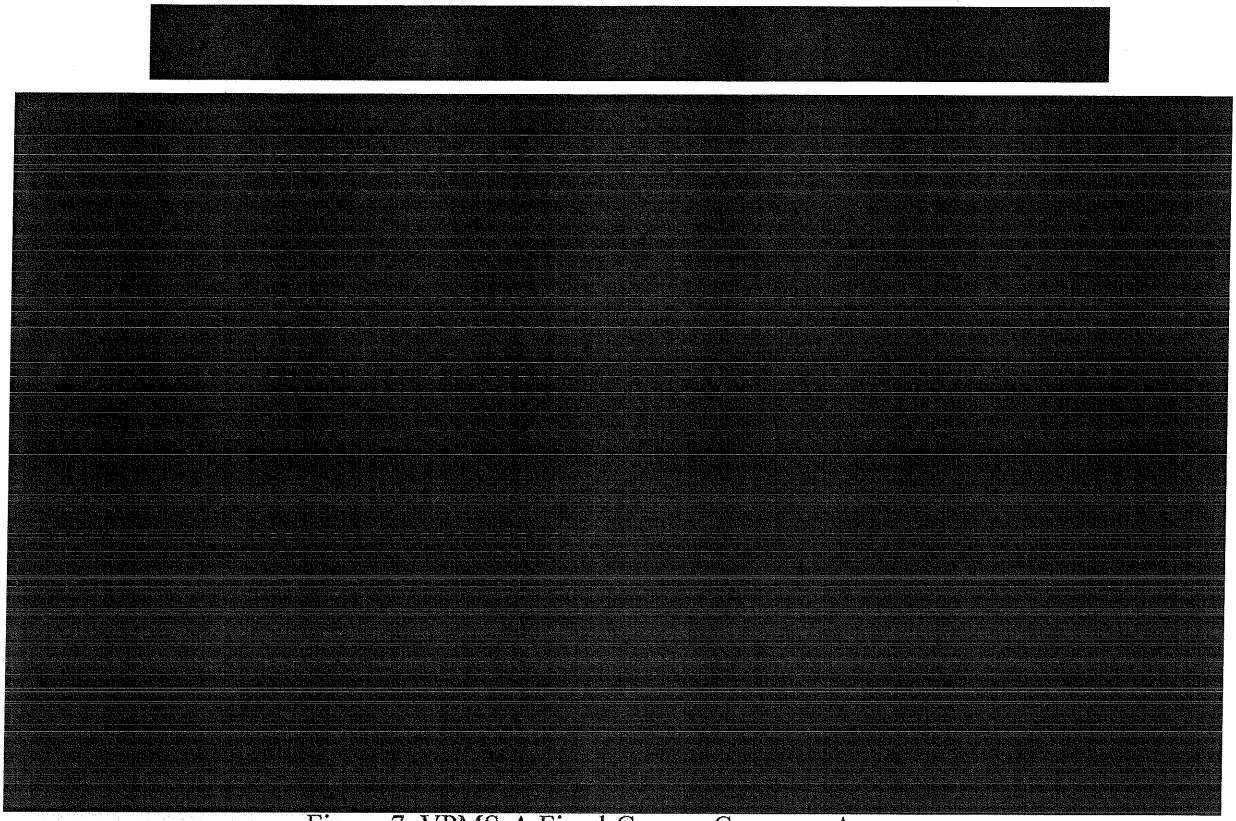


Figure 7. VPMS-A Fixed-Camera Coverage Areas

Camera nodes were typically composed of one or two cameras and the wireless communication equipment. Figure 8 shows an example of a typical camera node.

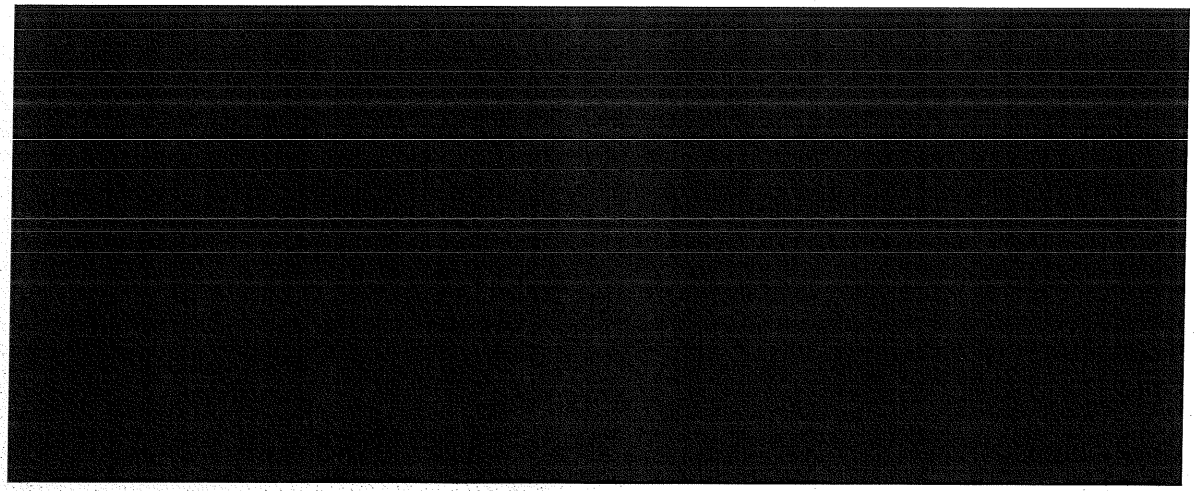
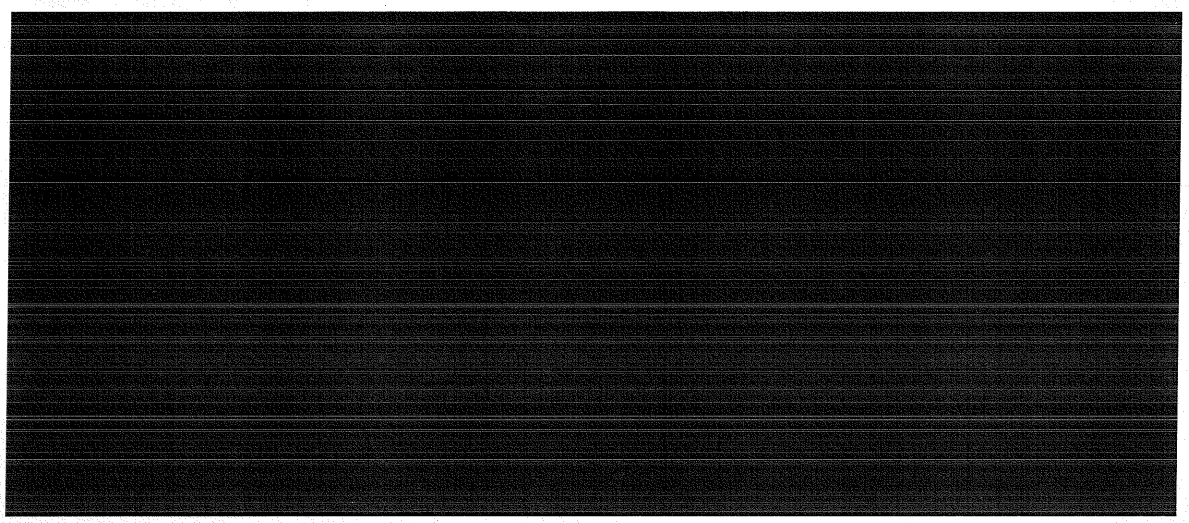


Figure 8. [redacted] Camera Node

[redacted]

Node components were selected based on the surrounding infrastructure, line of sight, and potential security risks. The directional antennas that were incorporated into each node communicated to a central hub that was [redacted] (Figure 9).



Live feeds from eight camera sources were processed through the video analytic component VEW™, which was developed by DRS Technologies, Inc. and powered by ObjectVideo. Through ObjectVideo, airport personnel were able to set up customized rule sets that provided automated detection of violations. The system configuration at HGR allowed for unattended monitoring of 8 different cameras; however, the software could be upgraded to accommodate a total of 16 cameras. The user interface software, Security Knowledge Manager™ by VideoNEXT Network Solutions, Inc., was designed to be intuitive for personnel with varying levels of computer proficiency. This interface was displayed on the COP. A 46-inch CCTV monitor (Figure 10) was mounted to the wall adjacent to the COP to allow other personnel who were not sitting in front of the COP to watch for activity on the surveillance network.

[redacted]

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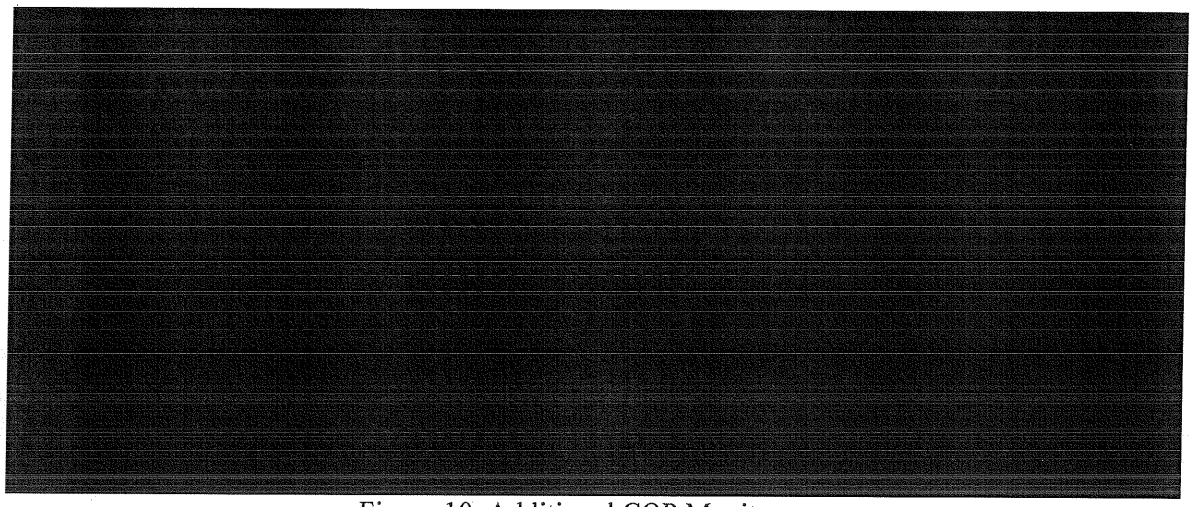
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Figure 10. Additional COP Monitor

4. METHODOLOGY

4.1 Sites

Safe Skies personnel performed a series of covert evaluation scenarios throughout the new surveillance infrastructure. Testing locations were limited to the [redacted] at which video analytic rule sets had been implemented.

4.2 Schedule

Evaluation scenarios were performed October 19 – 29, 2009, during both day- and nighttime conditions.

4.3 Test Personnel

[redacted]

4.4 Test Equipment

[redacted]

[redacted]

[redacted]

4.5 Critical Operational Issues

The objective of conducting system tests and data collection is to address Critical Operational Issues (COI), which are the primary issues of interest. In order to address the COIs, corresponding Missions and Tasks were established, which were used to develop the methods for collecting quantitative and/or qualitative information. The Measures of Effectiveness (MOE) and Measures of Performance (MOP) were used to develop the methodologies for gathering quantitative detection rate data.

Table 7. Critical Operational Issues

COI 1: How effective is the VPMS-A COP at enabling situational awareness?		
Mission	**Task**	
1 Is the system effective at improving incident response?	**A**	Determine the operators' perception of the system's capability to improve situational awareness.
	B	Determine the operators' perception of the system's data collection capabilities.
	C	Determine the operators' perception of the system's ability to facilitate coordination of incident responses.
	D	Determine the operators' perception of whether the system improves airport security.
	E	Determine the operators' perception of the system's access to stored data.
	F	Determine the operators' perception of the value of the system's stored data.
2 Is the system optimized for operation?	**A**	Determine any changes to the system employees would recommend.
	B	Determine what the employees think the system's strengths are.
	C	Determine any changes to the system's installation that employees would recommend.
	D	Determine if employees had any difficulty operating the system.
	E	Determine if employees would recommend the system for airport-wide use.
	F	Determine how this system compares with other similar systems they are familiar with.

[redacted]

[redacted]

COI 2: Within key location areas, how effective is the VPMS-A at HGR?		
MOE	**MOP**	
1 Does the system effectively and reliably identify ingressions at the **perimeter boundary**?	A	What is the observed rate of detection **from the perimeter boundary** into and through a *Boundary Zone(1)*, *Outer Zone(2)*, *Secure Zone(3)*, *Taxi and Runway Zone(4)*, or *Restricted Zone(5)*?
2 Does the system effectively and reliably identify transgressions into and through a **Restricted Zone**?	A	What is the observed rate of detection from a *Boundary Zone(1)*, *Outer Zone(2)*, *Secure Zone(3)*, or *Taxi and Runway Zone(4)* **into a *Restricted Zone***?
3 Does the system effectively and reliably identify transgressions into and through a **Taxi and Runway Zone**?	A	What is the observed rate of detection from a *Boundary Zone(1)*, *Outer Zone(2)*, *Secure Zone(3)*, or *Restricted Zone(4)* **into a *Taxi and Runway Zone***?
4 Does the system effectively and reliably identify transgressions into and through a **Secure Zone**?	A	What is the observed rate of detection from a *Boundary Zone(1)* or *Outer Zone(2)* **into a *Secure Zone***?
5 Does the system effectively and reliably identify transgressions into and through an **Outer Zone**?	A	What is the observed rate of detection from a *Boundary Zone* into an ***Outer Zone***?

5. RESULTS

To account for situations when a limited amount of data is collected, Safe Skies has established general guidelines for reporting confidence intervals (CI):

- For sample sizes of less than *15*, only the percent detected will be reported.
- For sample sizes of at least *15,* the percent detected and the associated Confidence Intervals (CI) will be reported.

All statistical tests are evaluated to an $\alpha = .05$ level of significance.

5.1 Evaluation Scenarios

[redacted]

[redacted]

[redacted]

Table 8. Site and Scenario Matrix

[redacted]

5.2 ObjectVideo Alarm Results

Events that took place within the view of the VPMS-A fixed camera equipment were processed by the ObjectVideo analytic component. If ObjectVideo determined that the event constituted a violation, it issued an alarm to VideoNEXT, which is the software that generated the user interface at the COP.

The following sections report results of alarms issued by the ObjectVideo component of the VPMS-A, which was responsible for the automated detection of violations within the areas covered by the video camera network. ObjectVideo performance data was compared to the OpSec results of the Baseline. It should be made clear, however, that the ObjectVideo software was an integrated component of the VPMS-A and was *not* viewed directly by the security personnel.

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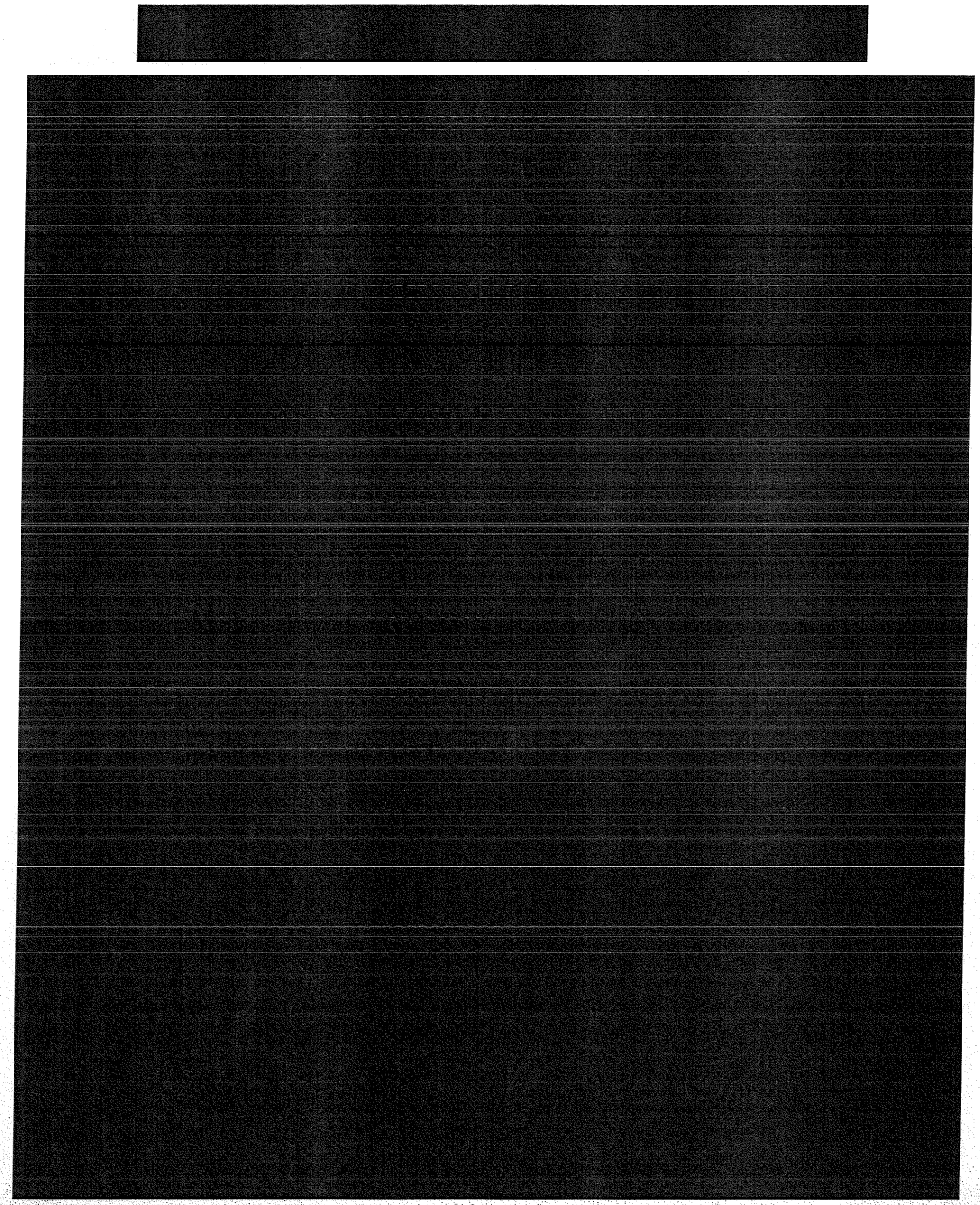
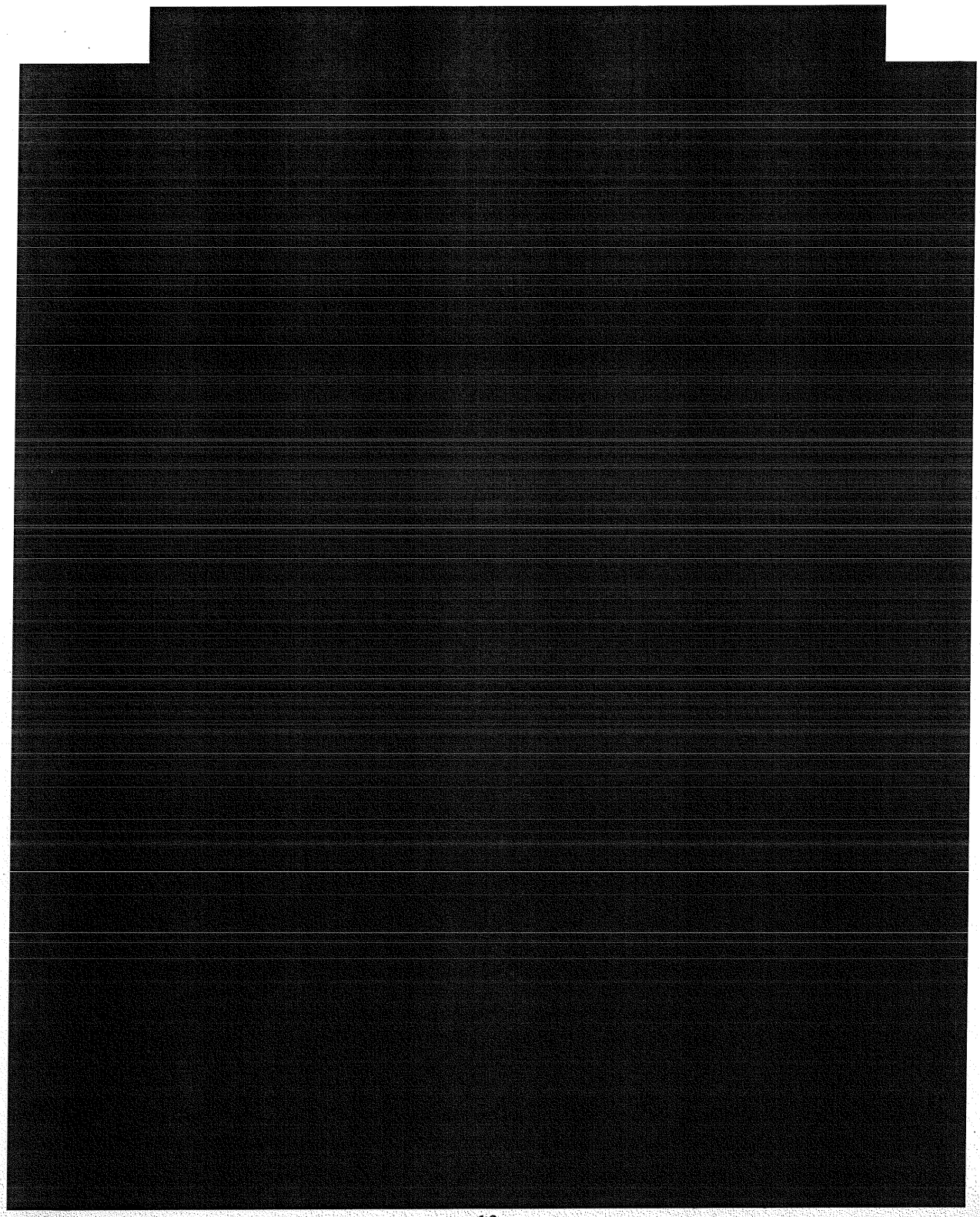
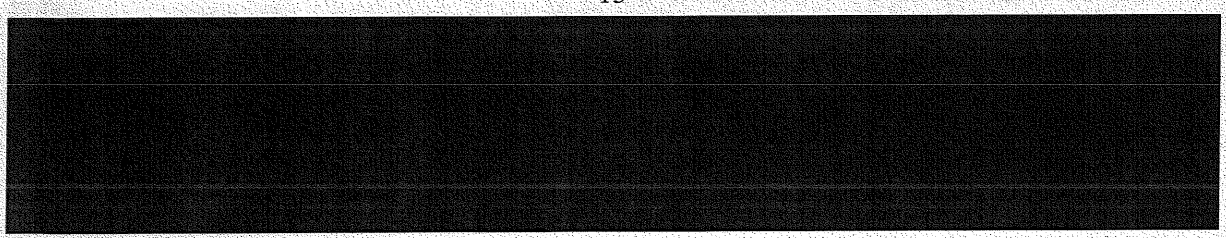
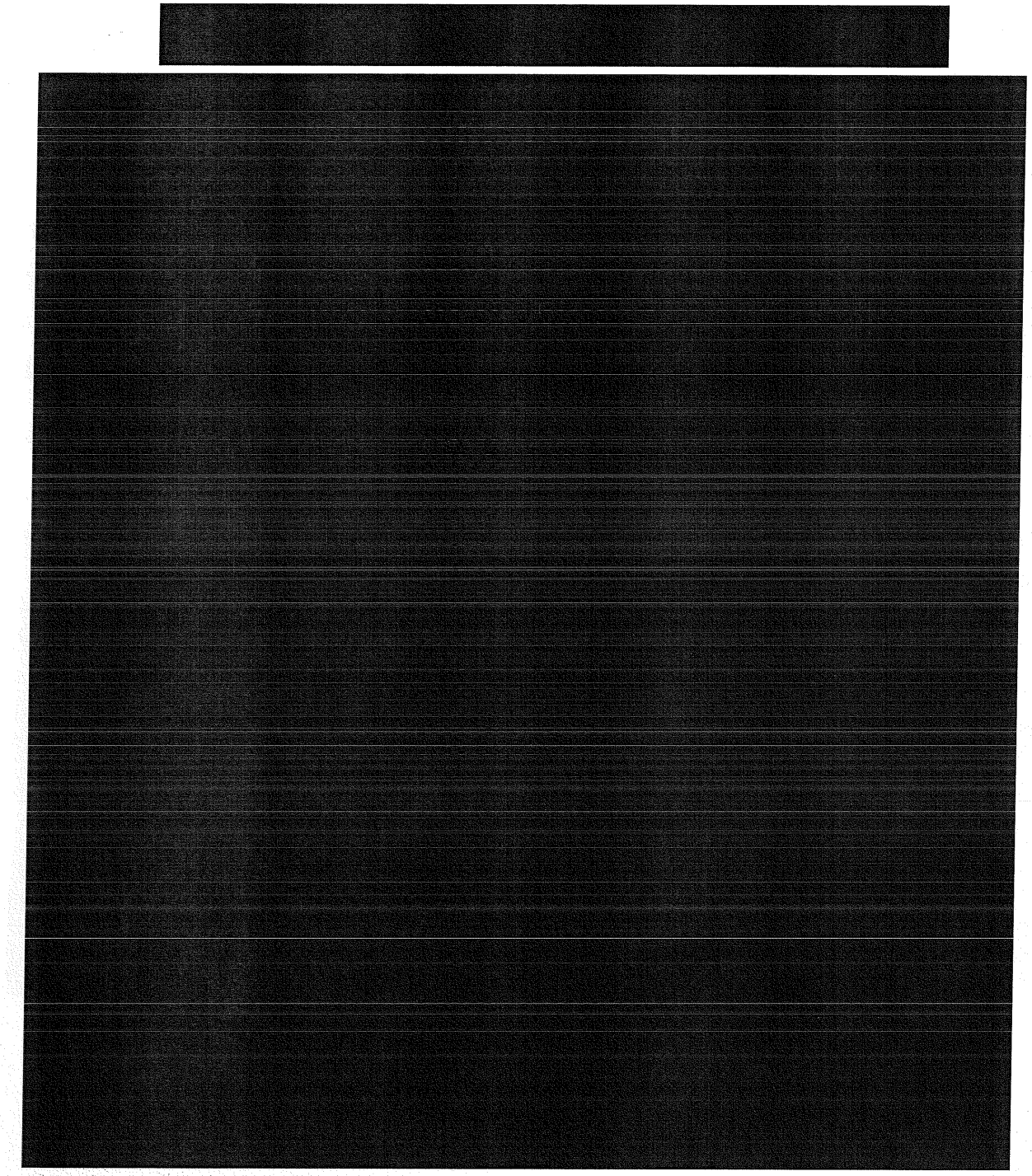
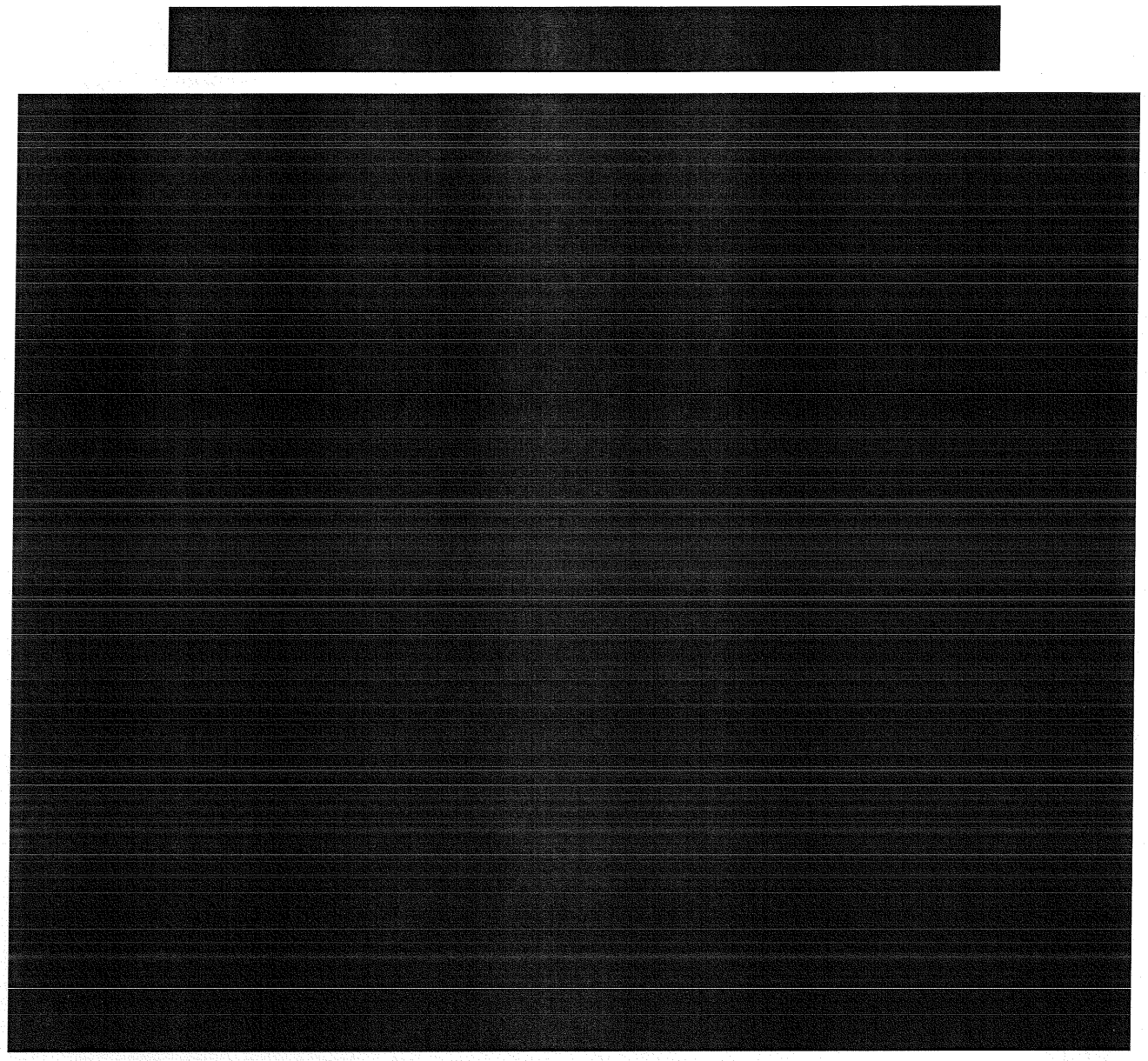










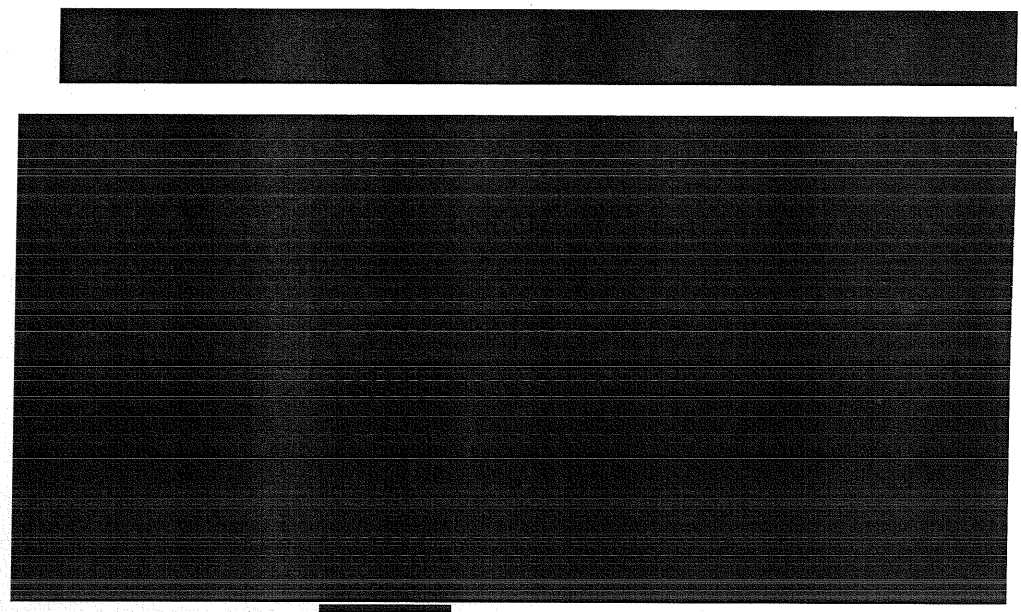


Figure 15. [redacted] – ObjectVideo Tripwire Rule 010

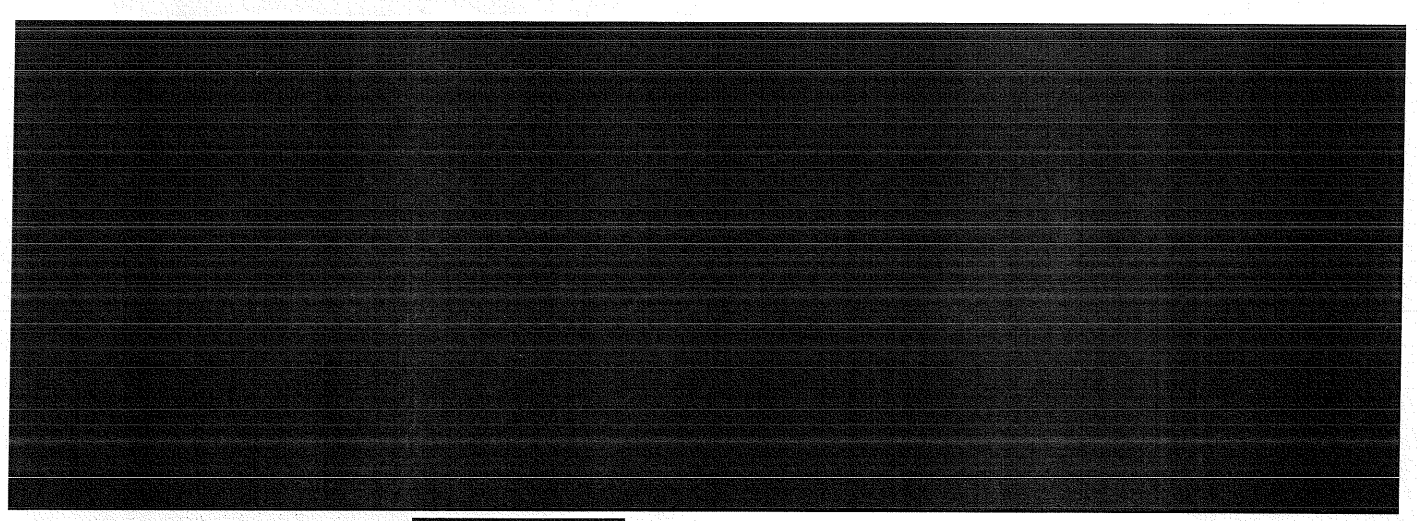
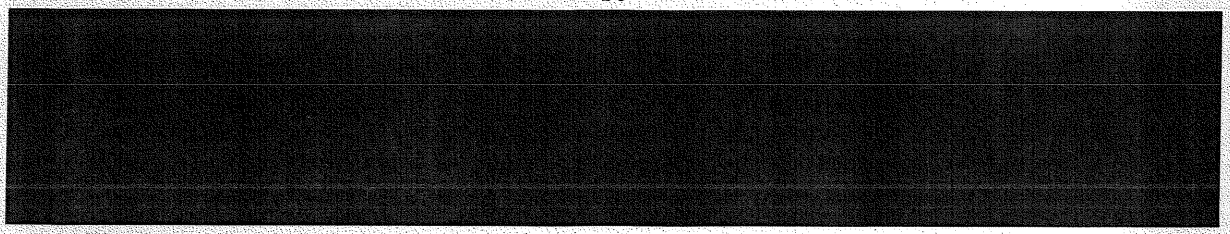


Figure 16. [redacted] – ObjectVideo Tripwire Rule 015

5.3 VideoNEXT Results

VideoNEXT, the user interface portion of the VPMS-A, aggregated the alarms issued by ObjectVideo and reported them to the end user.



[redacted]

5.4 User Surveys

Surveys were distributed to security personnel in order to assess the users' opinions regarding the VPMS-A as compared to the legacy security system. Surveys were distributed to security personnel or those that were trained in its operation and used both the legacy and VPMS-A systems. Only three surveys were returned: two from personnel with security background and training, and another from an office administrator. This was done in order to assess the users' opinions regarding the VPMS-A as compared to the legacy security system. Table 12 summarizes the users' responses.

Table 12. Survey Summary

When performing security responsibilities or responding to emergencies:		Never	Seldom	Some-times	Usually	Always	N/A or Don't Know
1 The incident alert provided by the system immediately attracts my attention	Legacy	[redacted]					
	New						
2 The system makes it easy to identify where an incident is located	Legacy						
	New						
3 The system quickly provides information needed to initiate an effective response to the	Legacy						
	New						
4 The system provides sufficient documentation of an incident	Legacy						
	New						
5 The system continues to provide monitoring/alerting of other covered areas during an incident	Legacy						
	New						
6 The system readily provides the information needed to respond to multiple incidents	Legacy						
	New						
7 The system readily provides the information needed to track multiple incidents	Legacy						
	New						
8 The system provides sufficient methods to document multiple incidents	Legacy						
	New						
9 Responses are effectively coordinated	Legacy						
	New						

[redacted]

[redacted]

10	Responses are effectively implemented	Legacy
		New
11	The system provides easy access to stored information from the *cameras*	Legacy
		New
12	The system provides easy access to stored information from the *sensors*	Legacy
		New
13	The system captures information that is useful for generating reports to the oversight	Legacy
		New

[redacted]

6. SUMMARY & OBSERVATIONS

[redacted]

[redacted]

[redacted]

7. REFERENCES

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[redacted]

[redacted]