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A Television Assessment and Identification System for the Plutonium Protection System

Donald A. Greenwoll

Sandia Laboratories

A TELEVISION ASSESSMENT AND IDENTIFICATION SYSTEM
FOR THE PLUTONIUM PROTECTION SYSTEM

Donald A. Greenwell
Facility Systems Engineering Division 1765
Sandia Laboratories
Albuquerque, NM 87185

ABSTRACT

This report covers the selection, description, and use of the components comprising the Television Assessment and Identification System in the Hanford Plutonium Protection System.

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Introduction

The Plutonium Protection System (PPS) is an item protection system that demonstrates advanced storage concepts which integrate detection and delay elements with careful monitoring and control of operational procedures. In addition, the accountability, operations, and security centers are physically separated to reduce vulnerability to insider threat. Organization of the PPS is illustrated in Figure 1. The five components of the PPS which are interconnected with a data communications network:

- The Storage Vault is an Item Control Area (ICA) in which advanced detection and delay elements reduce the vulnerability to insider and to forced entry threats. Personnel access is carefully controlled and the three control centers continually interact to assure the proper movement of material.

Figure 1. Plutonium Protection System Organization

- The Consolidated Material Packaging (CMP) room is an ICA which provides the point of entry to the PPS. Here, material is packaged into standardized containers to prepare it for storage. For this demonstration, the CMP room is under the direct control of the Material Operations Center; in actual application, its structure would be similar to that of a vault with direct control and interaction among the three control centers.
- The Material Operations Center (MOC) is a control center which monitors and controls all operations involving movement of items in the system.
- The Material Accountability Center (MAC) is a control center which maintains the accountability of all items in the system.
- The Security Operations Center (SOC) is a control center which monitors and responds to all alarms in the system and controls personnel access to various parts of the system.

Movement of material between the vault and the CMP room is accomplished in a secure fashion by means of a Secure Transport Module (STM),¹ which is essentially a minivault on wheels. The STM must be securely docked at a port in the wall of the ICA before material can be loaded or unloaded. The actual transport of material is carefully timed to minimize the time available for tampering or diversion.

The focal point of the PPS is the vault, which includes a personnel entry corridor,² alarm and assessment components, a protected computer, and a storage room that contains Secure Storage Modules (SSM).³ The first three items carefully control access to the storage area, while the SSM provides physical barriers and alarms to detect any attempt to gain unauthorized access to the stored items once entry to the storage area is achieved.

Closed circuit television (CCTV) is used throughout the PPS to provide a rapid alarm-assessment capability and to enable remote identification of personnel.

The primary function of the assessment portion of the CCTV system is to produce a picture of the area where an alarm occurs and to display the scene on a video monitor in the SOC operator's console. The operator can then determine quickly if unauthorized entry has been made. The CCTV system can also play a surveillance role by monitoring authorized personnel movements during normal transactions.

The identification function is handled by TV cameras which display the image of a person requesting access to the sensitive areas of the PPS. This image is compared by the SOC console operator to a televised file photograph⁴ of the individual requesting access.

Summary

In the PPS development project at Hanford, closed circuit television cameras are located in areas of critical importance. They assess intrusion alarms, identify persons requesting area access, and monitor routine authorized transactions and maintenance. These critical areas include the vault, both sides of the vault identification booth, and the entry corridor on the first floor of Building 234-5Z. On the second floor, an entry door and hallway and the ID booth areas are viewed by the assessment TV cameras. In addition, each ID booth contains a TV camera that views the face of a person requesting access for comparison with a TV-viewed file photograph of the authorized person. Another camera in the vault ID booth is positioned overhead to view the entire booth and determine the activity therein. Figure 2 is a layout of camera positions.

Figure 2. Physical Layout of Cameras (Dwg T59621)

All video lines exit the building and terminate in the SOC video equipment rack. The video lines pass through video clampers and are routed to the inputs of the Remote Video Switcher (RVS). Four outputs from the RVS are fed to four video monitors in the SOC operator's console. A fifth video output is used within the video equipment rack to monitor the camera video inputs for proper adjustments, when required. Figure 3 is a block diagram of the video system.

Figure 3. Block Diagram of TV System (Dwg WD-T59622)

Component Description

Assessment Cameras

All assessment cameras are Cohu Electronics, Inc. Model 2820B with $f/1.8$, 6-mm focal length lenses which produce a horizontal field of view of approximately 80 degrees. The image tube is a standard (antimony trisulphide) Type 8541A vidicon. The camera and lens are enclosed in an environmental housing, sealed from the outside atmosphere and pressurized to about 20 to 35 kPa (3 to 5 psi), relative to the atmosphere, with a nonflammable gas. Internal desiccant packs maintain a low-relative humidity.

The cameras were modified to include Curtis Model 520CP3 microcoulometer-type elapsed-time meters to indicate the total operating time of the cameras. The meter is visible through the glass faceplate of the camera. The vertical sync is locked to the ac power frequency (60 Hz) which reduces the effects of minor 60-Hz line noise induced into the video lines and provides smoother video switching from camera to camera in this multiple source system. The target voltage (camera sensitivity), electrical focus, and blanking level can be adjusted remotely in the SOC video equipment rack.

The environmentally enclosed camera was chosen to protect camera circuitry from moderate levels of radiation and provide relatively easy alpha decontamination of the exterior. The housing also keeps foreign matter from entering the camera circuitry and prevents an internal camera malfunction from creating a fire hazard to the surrounding area. A complete operation and maintenance manual is published by Cohu: Manual Code No. 6X-647, revised October 10, 1976.

Identification Cameras

The ID booth at the vault contains two television cameras, the ID booth at the MAC/MOC has only the face-viewing camera, and the photograph file has the fourth identification camera. All ID cameras are Telemation Model TMC-1100SD, with silicon diode array image tubes. Although they have somewhat reduced resolution when compared to the standard vidicon, the silicon array tubes have greater sensitivity and will not suffer permanent image burn-in when viewing high-light levels continuously. They do, however, produce extended highlight areas (blooming) if exposed to moderate- to high-light sources in the viewed scene. These cameras are not environmentally sealed, they cannot be remotely controlled, and the vertical sync is not line-locked as are the assessment cameras. A single RG-59/U coaxial cable brings the video output from each of the ID cameras to the SOC.

Cables

The cables connecting the assessment cameras to the camera control units are supplied by Cohu and are designated as CA-66 Cable Assemblies complete with factory-installed connectors. The cable consists of two coaxial (coax) cables, one seven-conductor shielded cable, three twisted pairs and eight individual conductors. These conductors are covered with an overall braided shield and jacketed with extruded polyurethane. The cable supplies ac power to the camera, the return video signal, and several remote control functions described previously. The cable lengths vary from 64 to 79 metres (210 to 260 feet) from the various vault-area cameras to the SOC. A wiring and function diagram of the cable assembly appears in the Cohu Camera Manual.

Cables for the identification cameras are RG-59/U coaxial cables (75-ohm impedance).

Camera Control Units

The camera control units (Cohu Model 2380-100) are used on the assessment cameras only and provide for the remote control of the ac power, manual or automatic control of the image-tube target voltage (sensitivity), electrical focus, and blanking level. These units, located in the SOC, allow necessary periodic adjustments to the camera as its operating time increases and its components age without the need for removal and disassembly. This capability is most significant when many video sources must have equivalent amplitudes and blanking levels to permit switching from one camera to another without having to readjust the monitor of each camera for contrast (video amplitude) and brightness (blanking level). If a malfunction occurs, the ac power to the camera can be turned off at the camera control unit to prevent further possible camera

damage. Camera power can also be turned off when cameras are not being used for long periods, thus extending the maintenance interval. The remote control unit also avoids the cost of installing power outlets at each camera location.

The ID booth cameras do not have this remote capability and must be turned on and off and readjusted in place. Since they are not ergonomically seated, adjustment controls are easily accessible, but access to the cameras through the vault may not always be available when required. To adjust these cameras, test equipment must be brought to the camera site and a maintenance computer transaction must be initiated to allow personnel to gain access to the vault and MAC/MOC ID areas.

Video Clampers

The video cables from the ID cameras and the remote control units of the assessment cameras enter the inputs of the video clampers. The purpose of the clamper is to eliminate the ac power signal induced into the video lines. The clampers used in this installation are Dynair Model CL-1050B which require a video signal input of at least 0.5 volt, peak to peak, to operate. If line losses were greater or longer cable lengths were used, a video equalizer would be required to bring the video level to the proper amplitude for input to the clamper. Two clampers are contained in each Dynair Module Frame Model FR-1000A and are supplied power by a Dynair Model PS-1006A Supply also contained in the FR-1000A Module Frame. A gain control on the front of the clamper module allows some limited adjustment to the video output amplitude. The clamper output video signal is available at two 75-ohm, source-terminated, unbalanced-rf connectors of either the uhf or BNC* type. A single video output connects the clamper to the RVS by RG-59/U coaxial cable.

Remote Video Switcher

The remote video switcher is a Cohu Model 9100 Video Switcher with a maximum capacity of 20 inputs and 5 outputs which produce a maximum of 100 video switching combinations or cross-points. The selection of a crosspoint, that is a particular input selected to appear on a particular output, is controlled by applying a positive-one logic signal (+5 volts) to the proper input control signal connector pin. The video output signal then appears at one of five output amplifiers. Each input video signal is applied to a single designated switch card which has five output lines. Only one input can be selected to appear at any single output amplifier card. Each output amplifier is designated for a particular monitor.

*Bavonet type of locking device developed by Neill and Concelman.

Four output amplifiers provide the video signals to the four video monitors in the SOC console. Three of these monitors display video signals which the SOC computer has selected and cannot be used manually. The fourth monitor is used to display the video from a camera manually selected by the SOC console operator. The fifth output of the remote video switcher is routed to the waveform monitor (oscilloscope) and a video monitor in the video equipment rack to use in the adjustment of the video level and in the diagnosis of problems (see below).

Video Monitors

The four video monitors in the SOC console and the single one in the video equipment rack are Conrac Model SNA9 series, with a 223-mm (9-in.) diagonal picture tube. In the SOC console, the monitors are mounted in pairs, each pair mounted in a side-by-side configuration in a single 483-mm (19-in.) rack frame, occupying 222 mm (8.75 in.) of vertical rack space. The video monitor in the video equipment rack is mounted in a side-by-side configuration with the waveform monitor in a common rack frame, requiring 222 mm of vertical rack space.

Diagnostic Equipment

When many video sources must be displayed on a single monitor, the characteristics of each source must be almost identical to those of all the other sources to preclude the necessity of adjusting the monitor brightness and contrast for each of the video sources. The only way to accomplish this is to observe the individual video sources and make remote camera adjustments accordingly. The waveform monitor is a special type of oscilloscope used to analyze the video signal; the standard oscilloscope is extremely difficult to synchronize from the video signal since all the sync pulses are of a constant amplitude but vary in frequency and duration. The waveform monitor used in this installation is a Tektronix Model 1480C whose output feeds a Conrac Model SNA9 video monitor in the same rack frame. With this combination, it is possible to set up the cameras for accurate dynamic range and peak-to-peak video amplitude. A video monitor alone will not provide the necessary information for accurate adjustments in multiple source systems.

A Dynair Model VS-121-A passive video switcher selects the input video to the waveform monitor. The video inputs are obtained from the bridging (high impedance) inputs of the remote video switcher by RG-59/U coax cable. All of the video lines are terminated in 75 ohms in the passive video switcher except the manually-selected video source which is terminated at the waveform monitor input.

A video switcher simulator/tester is a device inserted between the control inputs from the computer and the RVS. A light emitting diode (LED) is connected to each video crosspoint in the RVS to indicate which crosspoints are activated. During installation and checkout, the simulator/tester can substitute for the computer and manually-controlled inputs to verify operation of the switching and display equipment. When normal operations are established the simulator/tester

can be used to isolate any control or switching problems which may develop, or can be used when control signals from the SOC computer are not available, whatever the reason.

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US Department of Energy

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Division of Safeguards, Fuel Cycle
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