# ITEM IDENTIFICATION SYSTEM FOR MATERIAL ACCOUNTANCY GLOVE BOXES

C. S. Johnson, W. R. Hale, R. L. Martinez
Sandia National Laboratories*
Albuquerque, NM 87185 USA

T. Ohtani, S. Takahashi, M. Seya
Power Reactor and Nuclear Fuel Development Corporation
Tokai-Mura, Ibaraki--Ken, Japan

S. Bourrett, S. Klosterbauer, J. Painter
Los Alamos National Laboratories
Los Alamos, NM 87185 USA

SAND--90-0769C

DE90 013842

## Abstract

The Power Reactor and Nuclear Fuel Development Corporation (PNC) has installed an Item Identification System (IIS) for their Material Accountancy Glove Boxes (MAGB) in its Plutonium Fuel Production Facility at Tokai-Mura, Japan. PNC entered into an agreement with the US Department of Energy to have Los Alamos National Laboratories (LANL) and Sandia National Laboratories (SNL) develop the specialized hardware to be used in this application.

LANL developed a MAGB Counter which is used to monitor glove boxes during interim inspections and physical inventories. The counter detects when a sample has been placed in a glove box and begins a measurement on the sample. During the measurement process, the counter will send a trigger signal to a Video Surveillance Unit which was developed by SNL. The signal will cause a video recording to be made of the identification number of the sample being measured. This paper discusses the installation and performance of the Item Identification System.

## Introduction

The Item Identification System for Material Accountancy Glove Boxes consists of two subsystems-a MAGB Counter and a Video Surveillance Unit. (See Figure 1.) The MAGB Counter was developed by Los Alamos National Laboratories and consists of a Neutron Coincidence Counter, a JSR-11 Shift Register, and a Compaq Portable III Computer (Ref. 1). The equipment is mounted in the top part of the equipment cabinet shown in Figure 1. The Video Surveillance Unit (VSU), developed by Sandia National Laboratories (Ref. 2), is mounted in the lower portion of the equipment cabinet.

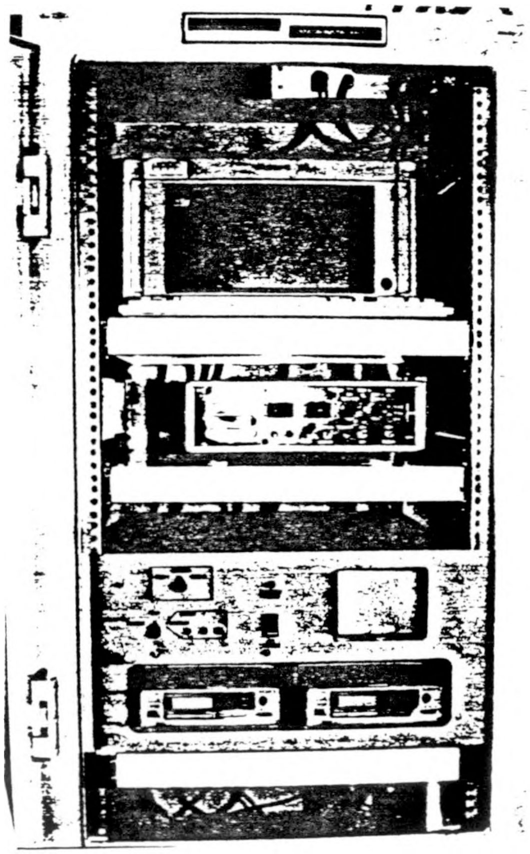

Figure 1
Item Identification System for Material Accountancy Glove Box

Three systems have been installed in the Plutonium Fuel Processing Facility (PFPF) while a fourth system has been installed in the Plutonium Conversion Development Facility (PCDF). The VSU's were installed during the third week of May, 1990. The MAGB Counter had been previously installed by Los Alamos personnel.

The Item Identification System is designed to provide a method for inspectors from the International Atomic Energy Agency (IAEA) to request randomly selected canisters containing mixed oxide fuel to be pulled from storage to verify their contents. The radiation detectors will provide an indication of the amount of the fuel in the canister, while the video system will provide a verification of the presence of the canister and its serial number during the time the radiation measurement is being made.

The VSU consists of a rack mount chassis and a camera enclosure (See Figures 2 & 3). The camera enclosure contains a solid-state camera and a video authentication processor module. The chassis contains a microprocessor-based controller board, two EVO-210 8mm video cassette recorders, a video authentication verifier module, a universal power supply, a video monitor with a 140mm screen, and a solid-state switch and timer that provides power to the video monitor for a specified time (See Figures 4 and 5).

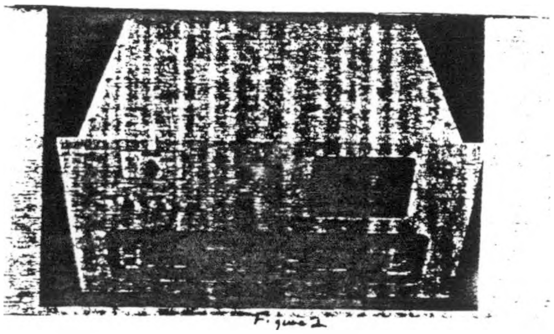

Figure 2
Rack-mounted chassis of Video Surveillance Unit

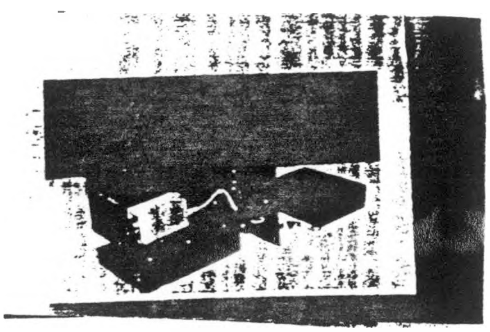

Figure 3
Camera enclosure of Video Surveillance Unit

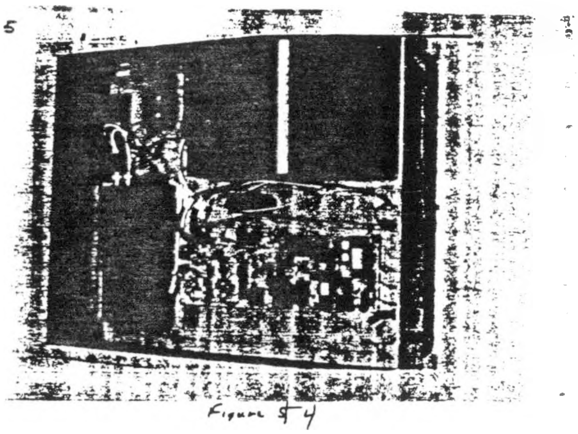

Figure 4
View of Components Mounted on Top Shelf of VSU

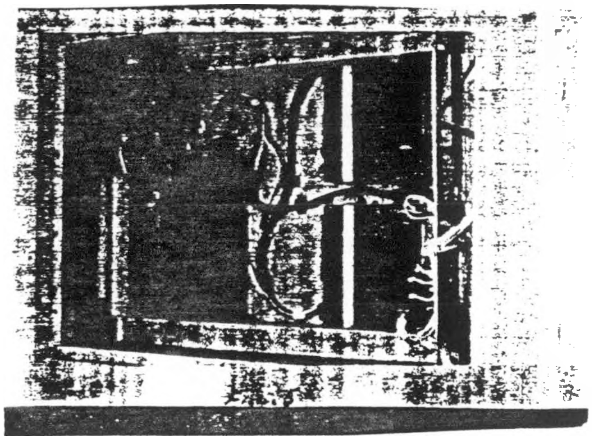

Figure 5
View of Components Mounted in the Bottom of the VSU

System Operation

The theory of operation is as follows: The VSU interfaces to the computer in the MAGB Counter. The MAGB Counter detects the presence of a canister containing material in the material accountancy glove box and sends a signal to the VSU which makes a real-time recording of the canister present in the glove box. The duration of the recording is determined by an IAEA inspector when the system is placed into operation and car be selected from 1 second to 99 seconds. The camera of the VSU is focused on the serial number on the canisters. No additional recordings are generated until the next time a record command signal is received from the computer in the MAGB Counter.

The block diagram of the VSU is shown in Figure 6. The video signal from the camera goes to the Video Authentication Processing Module (VAPM). The rack of equipment is only connected to the radiation detectors and the camera when measurements are to be made. Once power and video connections are made, the system will begin to automatically authenticate the video cable between the camera housing and the VSU.

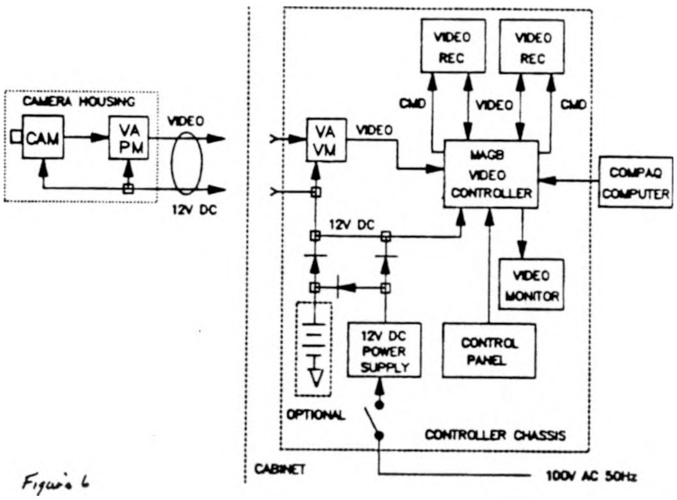


Figure 6
Video Recording for the
Item Identification System

The video output of the VAPM is sent over a coax cable to the VSU where it is processed by a Video Authentication Verifier Module (VAVM). The authenticated video signal from the VAVM enters the controller's video processing circuitry where characters are inserted into the video signal. The character display shows the date/time, any tamper information, and the programming instructions (program mode only). The video containing the inserted characters is routed to both recorders where it will be recorded whenever the controller module issues a record command.

The control of the system is accomplished with an 87C51 CMOS microcontroller. The microcontroller controls and reads the clock integrated circuit which has a built-in battery backup to prevent the loss of date/time when there is an extended loss of power. The output of the clock circuit is constantly displayed in the video by sending the time information to a CMOS character generator integrated circuit. The character generator has an internal sync generator that allows date/time characters to be displayed in the event there is a loss of video from camera. The characters are annotated onto a blue background. The position of the characters on the screen are fixed by the software program at the bottom of screen and are not field programmable.

The system monitors high and low temperature sensors, and loss of camera sync. These events are annotated on the video in the following manner: HI - High Temperature, LO - Low Temperature, VID - Sync Loss. The microcontroller also sends the commands to the Sony serial data integrated circuit that communicates constantly with the video recorders. This system sends the commands to the recorders to execute a video recording in real-time. In between the recording time, the recorders are not active and all power to the recorders is turned off.

Power for the VSU is supplied from a universal power supply that allows AC mains input voltages from 90 to 260 V, 44 to 440 Hz as a power source.

There are two recorders in the VSU chassis. The presence of two recorders increases the reliability of the system. The IAEA inspector can review the data from only one recorder at a time, with the other recorder providing back-up. Figure 3 shows the location of the EVO-210 recorder controls. The recorder can be operated directly when mode switch is set to "Review". The monitor, which has a 140 mm screen size, operates on 12v DC that is provided by the power supply. The monitor can be utilized during system verification of camera field of view or during review of the tape from the recorder. This is accomplished by depressing the "monitor power switch", setting mode switch to "Review", selecting "REC 1" or "REC 2" and operating the corresponding recorder. Utilizing the monitor for data review is not optimum due to the small screen size and its location in the lower half of the rack. It may be preferable for the tapes to be removed for review at another location utilizing an 8mm recorder and a large screen monitor. An external timer will automatically turn power off to the monitor approximately 6 minutes after the monitor power switch is depressed.

## Installation

The installation and testing activities of the Item Identification System were conducted during the week of May 21, 1990 at PNC. Inspectors from the International Atomic Energy Agency (IAEA) and the Japan Nuclear Safety Bureau (JNSB) participated in the activities. Time was spent thoroughly analyzing the complete operation on all the systems. This included transferring different types of canisters into the glove boxes, utilizing different lens on the cameras to provide the optimum video image of the serial numbers for the different types of canisters, and verifying that the systems would only record when actual material was present in the canisters. The PNC operators transferred canisters with mixed oxide fuel into the glove boxes, after system installation, to permit verification of system operation. Different scenarios were simulated with canister movements to check the operation of the trigger to the video recording system. The purpose was to verify that no trigger (video recording) was requested while the glove box was empty. The system operated satisfactorily in all tested scenarios and recorded only when a canister was in camera field of view. The overall installation was successful. It is expected that the Item Identification Systems will be placed in routine use in July 1990.

## Summary

The Item Identification Systems in operation at PFPF and PCDP will provide a reliable unattended method to monitor the mixed oxide fuel in the facilities that will require less manpower for both the inspectorates and PNC. After the random selection of canisters has taken place and the IIS programmed, the system can be left to collect data as the operator moves the canisters selected into measurement location over the next 32 hours. After the end of the measurement period, inspectors will be able to return to the IIS and collect the data and view the video tapes.

## References:


1. M. C. Miller, et al, "Remote-Controlled NDA Systems for Process Areas in a MOX Facility," Proceedings, 30th Annual Meeting, INMM, pp. 274-280.

2. R. L. Martinez and C. S. Johnson, "Video Surveillance Unit," Proceedings, 31st Annual Meeting, INMM (to be published).


---


*This work was supported by the U.S. Department of Energy under Contract #DE-AC04-76DP00789, and by the Power Reactor and Nuclear Fuel Development Corporation.