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Mobile Waste Inspection Real Time Radiography System

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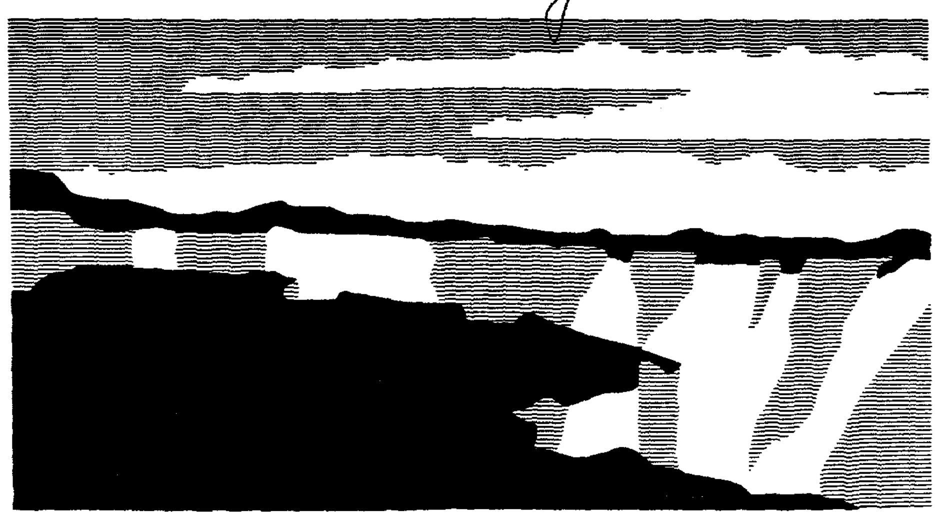

Los Alamos
NATIONAL LABORATORY

MOBILE WASTE INSPECTION

REAL TIME RADIOGRAPHY SYSTEM

by

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ABSTRACT

The 450-KeV Mobile Real Time Radiography System was designed and purchased to inspect containers of radioactive waste produced at Los Alamos National Laboratory (LANL). The Mobile Real Time Radiography System has the capability of inspecting waste containers of various sizes from 5-gal. buckets to standard waste boxes (SWB, dimensions 54.5 in. × 71 in. × 37 in.). The fact that this unit is mobile makes it an attractive alternative to the costly road closures associated with moving waste from the waste generator to storage or disposal facilities.

INTRODUCTION

The Radioassay Nondestructive Testing (RANT) Facility , previously the NDA/NDE Facility, was built in the late 1980s and began operation in 1990. Approximately 1000 55-gal. drums of radioactive waste were examined in the facility using a 320-KeV Real Time Radiography system and a Passive Active Neutron (PAN) system. The RANT Facility was put in a "stand down" mode in 1991 when it was discovered that the facility did not have all of the required documentation to continue operation. Being in stand down, the facility left a void in verifying drum contents and fissile content. It became apparent that the documentation required to bring the facility out of stand down had become time consuming, costly, and due to the ever-changing regulations, was not going to be completed in the near future. An alternative to bringing waste into the facility was required. The LANL team decided that it would pursue the concept of having mobile systems to perform NDA and NDE operations. The concept of having mobile NDT systems to perform NDA/NDE was not new. A few years earlier, LANL had developed four prototype NDA/NDE systems (two NDA and two NDE). These systems were field tested at the Nevada Test Site and at Idaho National Engineering Laboratory (INEL). They performed well, but because they were prototypes, they were somewhat crude. We decided we would build a state-of-the-art Mobile Real Time Radiography system that would be completely mobile and self-contained.

REAL TIME MOBILE WASTE CONTAINER INSPECTION

In 1993 we started the process of searching for a vendor who could build a Mobile Real Time Radiography (RTR) to our specifications. We based our specifications on the experience we had using our stationary RTR system. We initially received three bids. The contract was awarded to V.J. Technologies of Long Island, New York. Construction of the unit began in November of 1994. We chose to go with a more powerful x-ray system (450 KeV) than our stationary system because we had the need to radiograph larger and more dense objects (e.g., overpack drums, SWBs, and lead-lined drums), and we knew, through experience, that a 320-KeV system would not provide the results we needed.

This paper outlines the procedure for inspecting radioactive waste containers with the mobile x-ray unit using an RTR system with an image intensifier and/or a linear array detector, or a open system. It also explains why we specified these imaging techniques.

The entire system is housed on triple-axle, 51-ft semitrailer. The trailer provides a completely mobile facility to allow x-ray inspection of the contents in the closed waste containers. The trailer contains the operator control room, a lead-shielded x-ray inspection chamber, multiple storage rooms and compartments, and AC power generator, a climate control system, an automatic fire suppression system, and container handling equipment. The control room contains all the necessary equipment to allow the operator to remotely enable the x-ray generation, imaging, container manipulation, and data storage systems. The trailer was built on three axles because of the added lead shielding required to shield the operators and public from the x-rays. The lead-shielded inspection chamber was built to stationary x-ray cabinet standards. Due to the cost of the trailer and its contents, we were required to have a self-contained fire suppression system built into the trailer. The trailer can be powered either from local house power or its self-contained generator.

The open system is comprised of a 33-in. by 27-in. fluorescent screen, a mirror, and a TV camera all enclosed in a lead-lined box. This system allows the operator an 891-in.^{2} area view of the contents inside the container at one time, an entire 55-gal. waste drum can be viewed at once. This allows the operator to view the entire drum and locate regions of interest that can be inspected for more detail using one or both of the other imaging systems. The Image Intensifier box is mechanically linked to the x-ray tube and travels with the tube to allow viewing different areas of the container. The TV camera output is a video format that is fed to operator-selected image enhancement circuits then to both display monitors and videotape recorders.

The Image Intensifier also is provided with an operator-selected magnification mode enlarging the image in the selected area. The Image Intensifier and the Open System allow jogging motion, and depending on the container, rotation which is helpful and in some cases required to locate liquids which may be present in a container.

The Linear Diode Array (LDA) acquisition system is comprised of the following components:

- single 588-pixel LDA;
- dual power supplies;
- dual analog/conversion/buffering electronic packages;
- host acquisition computer interface cards; and
- associated cabling.

The LDA is also mechanically linked to the x-ray tube, both of which travel together in the vertical plane. Waste containers are placed between the x-ray source and the LDA. Software running on the host computer allows the operator to initiate an LDA scan once the LDA manipulator is in the start position and x-rays are turned on. As the manipulator passes the LDA in front of the container, the computer receives scan-line data from the conversion/interface electronic. The computer assembles each consecutive scan line into memory for subsequent display on the operator monitor and/or subsequent image processing operations (Fig. 1). Raw or processed image data can also be stored in the computer's optical storage subsystem for later recall or further analysis. The LDA technique is the same as your standard airport luggage x-ray system. Unlike the Open System and the Image Intensifier, the LDA is not real time, but the information that is gathered can be analyzed and reconstructed to a greater detail using imaging software packages.

The loading and manipulating of the waste containers require a forklift to load the container onto the lift table. Once the container is loaded on the lift table, the lift table will position the drum/SWB to the same height as the conveyor system which is fixed inside the x-ray vault. The interior conveyor system will carry the waste container into the x-ray vault and proceed to position it onto the rotary table. The operator assures that there is nobody in the x-ray vault and closes the x-ray vault so the inspection may begin. From a single control station, the operator selects the imaging system to be used. After the imaging system is selected, the operator can manipulate the x-ray source to the desired position to inspect the waste container. During the inspection, the operator will add audio to the VCR tapes that are recording the inspection. The audio will include any findings of interest as well as locations of items in the containers per the Waste Acceptance Criteria (WAC) that is being used for the inspection. The operator uses image processing and enhancements during the inspection. Items or areas of interest may also be made into a hard copy image using the video copier on the system. The rotary table will be used to rotate waste drums during the inspection. Due to the size of some of the waste containers, such as the SWB, they cannot be rotated in the x-ray vault but they will be inspected on one side, then the operator will open the vault door and reverse the conveyor direction. At this point, a forklift will again be used to remove the SWB from the lift table, turn it around, and then place it back on the lift table and continue with the inspection.

Conclusion

In conclusion, the need for mobile radioactive waste container inspection at LANL is a necessity to avoid unnecessary movement of radioactive waste. The Mobile RTR system can be taken directly to the waste generator site for inspection to see if it conforms to their WAC. If the inspection reveals that a particular waste container is not acceptable, the container can be opened and repackaged at their facility before shipping it to storage or disposal. Another use of this system is in the retrieval of waste that has been stored in earthen cover for the past twenty years. The mobile unit will be taken down to the retrieval site and as the drums are exhumed, they will have an RTR to determine the contents of the waste containers. The fact that these drums have been buried, and in many cases lack sufficient documentation of the contents, also adds to the versatility of this unit. If there was not a mobile unit, the drums would have to be transported to a facility that had RTR capabilities requiring road closures and possible leakage of corroded drums.