DEVELOPMENT OF AN AUTOMATED WASTE MANAGEMENT SYSTEM

TO AID IN COMPLIANCE WITH 10 CFR 61

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ABSTRACT

TVA, in an effort to respond to new federal regulations, developed an action plan to reduce the manpower, sampling and cost for compliance with 10CFR61. This paper reviews the development of programs and equipment procured by TVA to meet the new regulation in a cost effective and efficient manner.

BACKGROUND AND HISTORICAL OVERVIEW

To comply with the NRC's 10 CFR Part 61 requirements, TVA embarked on a three point development program. It included 1) a barrel Curie monitor with the capability to perform direct isotopic analysis, 2) a computerized radwaste management program and 3) a sampling program coupled with computer modeling to reduce sampling costs. TVA contracted with Impell Corporation to supply the radwaste program which included provisions for meeting the new regulation.

The research and development effort was headed by TVA's Energy Development and Technology (ED&T) Branch. The early focus was to develop a barrel Curie monitor which could provide direct isotopic analysis of each final waste package. Two major reasons existed at that time for the Curie monitor. The first was based on the possible use of volume reduction equipment. That would cause a significant increase in dose rate of the waste. Problems would have resulted in both sampling and analysis. The second was the TVA interpretation of the requirements of the proposed Part 61. It was believed that waste classification had to be based on a detailed isotopic analysis of each container. TVA developed a bid specification based on literature, research data and information supplied by EG&G, Ortech and Canberra. At that time, the cost of the Curie Monitor system was estimated at $250,000.

After the NRC issued clarifications on the new rule, it became clear that TVA's interpretation was overly restrictive. Waste classification could be based on a dose rate-to-Curie conversion for any individual container. With the new understanding of the ruling and the subsequent cancellation of the volume reduction equipment, the need for a complex GeLi based barrel Curie monitor was eliminated. A more practical approach was adopted which utilized the dose rate-to-Curie conversion concept and an isotopic distribution based on conventional sampling.

A version of the barrel Curie monitor was conceived which would work in concert with a computerized waste management system. The Curie monitor would automatically collect container dose rates. It would then pass the information to the waste management program for conversion to Curie content by isotope. A bid specification was developed for equipment which was consistant with this ratioing method.

The new specification was for a dry active waste (DAW) barrel Curie monitor which performed gross activity assay and a weight measurement for each container. The monitor had to pass activity and weight measurements to a central processing microcomputer. The gamma activities needed to be:

1) Converted to dose rates,
2) Given a container identification number consistant with the radwaste management program and

3) Calibrated with accuracy to meet 10 CFR Part 61 paragraph 61.55 and other applicable local, state or federal regulations.

The system was to contain a conveyor-based monitor for processing barrels, a hand-held probe for measurement of boxes and a central data processor. As a result of a competitive bid, Impell was awarded the contract for this phase of the program as well. The cost of this system was reduced to under $100,000.

A second part of the overall program was a computerized radwaste management program called WASTETRAK which was purchased from Impell. In addition to managing data for each radwaste container, the program also contains routines for cost estimating, generating shipping papers, cask selection and packaged waste storage management. Part of the specification for the barrel Curie monitor required that it interface directly with the waste management program resident on a PRIME 450 computer. The program supports the dose-to-Curie conversion and scaling factors allowed by Part 61.

The third part of the program was sampling, laboratory analysis and computerized modeling. Laboratory analysis work was performed by EAL Corporation. Impell then used these results and other industry samples to develop a program for generating and using scaling factors to aid in classification of radwaste. (Classification of radwaste using these scaling factors was also made a part of the radwaste management program.) As a result of the modeling developed by Impell, TVA was able to meet Part 61 requirements with minimal sampling and significant cost savings.

CURIE MONITOR DESCRIPTION

The Impell Barrel Curie Monitor System is designed to measure weight and dose rate for radioactive waste containers. It also provides an interface for entering that and other information about the waste into the radwaste management program which is being used for tracking and shipping DAW.

The equipment for the Curie Monitor includes two monitoring stations and interfaces with a third. The Conveyor-based Monitor, Fig. 1, automatically measures the weight and dose rates of 55 gallon and 85 gallon drums. The Hand-Held Monitor measures up to six dose rates from odd sized containers and can be used to find peak dose rates. Weight and dose rate for very low activity bagged waste can be obtained from a Bagged Waste Monitor supplied by NNC.

Control of the two monitors, data gathering from the three monitors and communication with WASTETRAK is accomplished by the software program, BARRELTRAK. Running the program and interfacing with the instruments and equipment is provided for by the Central Processor, a Hewlett Packard HP9920 microcomputer.

Fig. 1. Conveyor-based Monitor.

Conveyor-based Monitor

The Conveyor-based Monitor, shown in Figs. 2 and 3, consists of a powered live roller conveyor, a weigh frame and four radiation monitors with GM tube detectors. The conveyor is divided into three sections: feed, measurement station, and takeaway.

One section is powered, and the other two operate as slaves. The weigh frame is located under the measurement section. A frame surrounding the conveyor measurement section supports a motor-driven Rotating Arm and four GM detectors mounted on the arm. The Rotating Arm and detectors scan the container for both peak and average contact dose rate.

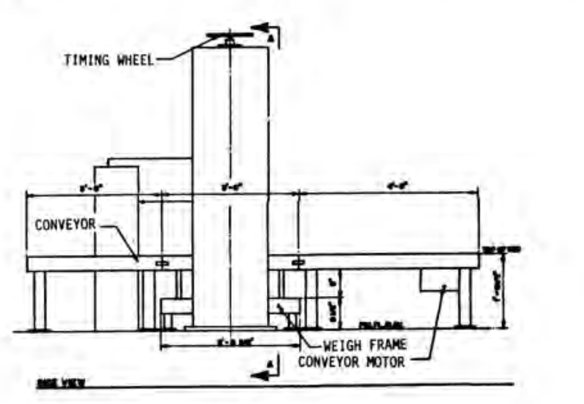

Fig. 2. Conveyor-based Monitor Side View.

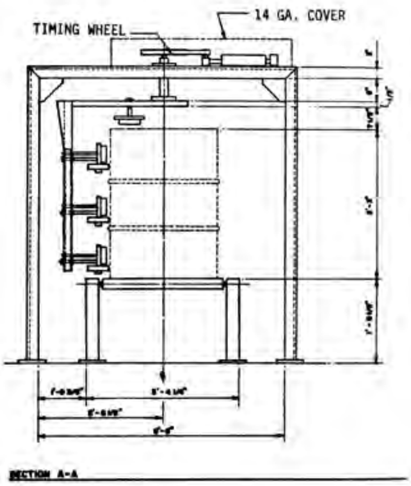

Fig. 3. Rotating Arm Detail.

For operation of the Conveyor-based Monitor, the containers are placed on the feed conveyor. The operator starts the conveyor which transfers the containers to the measurement station. A light beam detector stops the conveyor when the container is in the correct position. The weight is taken and recorded under the direction of the Central Processor. The light beam detector also activates the Rotating Arm, Fig. 4, which is rotated one revolution around the container. Three GM detectors are mounted vertically along the height of the container and one over the top. At a speed of 1 RPM, each detector measures the counts for 10 separate divisions around the circumference of the container. The counts for each division are passed to the Central Processor. When the scan is complete, the processor determines the peak contact dose rate. An additional calculation is done to determine the average dose rate to use in the radwaste management program for the dose-to-Curie calculation. A limit switch stops the Rotating Arm and starts the takeaway conveyor.

The system can measure dose rates in the range of 0.5 to 1000 mR/hr on contact without the need for manual scaling. Lead shielding is provided around three sides of the detectors to reduce background and provide for an accurate count. The system can process containers up to a maximum weight of 1000 pounds. It can handle up to 20 containers per hour.

Hand-Held Probe

The Hand-Held Probe provides for measurement of gross gamma activity for large or irregular containers. The probe is fitted with a trigger to signal start of a measurement. Up to six measurements may be taken for each container. The average of the six readings is used for dose-to-Curie conversion. One additional reading may be taken for peak dose rate after location by the operator. The capability for converting dose-to-Curie in the radwaste management program is supported by the Hand-Held probe. Containers are modeled as a right circular cylinder or a rectangular box. Up to 25 sizes can be supported.

Fig. 4. Rotating Arm.

The detector is capable of a 5 decade range from 0.005 to 50 R/hr without the need for manual scaling. It operates on up to 50 feet of cable. Response times of less than 8 seconds are achievable at the low end of the scale. The detector is rugged and capable of withstanding a 3 feet drop.

Central Processor

The components of the Central Processor include the Hewlett Packard Series 200 Model 20 microcomputer, a dual disk drive, a dot-matrix printer, and the BARRELTRAK software program. The program is written in BASIC. It is designed to:

- control the functioning of the Conveyor-based and Hand-Held Monitors,
- record container data from the Conveyor-based Monitor, the Hand-Held Monitor and the Bagged Waste Monitor,
- communicate the container data to the radwaste management program on the PRIME computer,
- run in a terminal emulator mode to execute the radwaste management program interactively from the HP9920,
- print shipping manifest forms or other program summary output.

Operation of BARRELTRAK is facilitated by use of data libraries similiar to those used with the radwaste management program. They provide for security of the program: selection of container types, waste streams and waste forms; and constants which are plant specific, equipment specific or regulatory related. These files can be easily updated using protected menu options.

The general container information entered manually includes the following:

- waste stream
- waste form
- container subtype
- batch number
- storage location (if desired)
- contamination values (if different from default)
- number of dose rate readings (Hand-Held Probe only)

Container data entry routines for both the radwaste management program and the Central Processor software are identical so that the entry format is familiar to the operator. Selections for the first four items above are stored in data files on the Central Processor for easy modification or updating. The operator need only enter the character code for the appropriate selection.

Automatic data entry is done for the following:

- container identification number
- date and time
- gross weight (manual for the Hand-Held Probe)
- gross gamma assay (average and peak readings)

The information is stored in the Waste Container Information File along with PRIME commands which can execute the radwaste management program. When passed to the Prime 450, this file actually runs the radwaste management program automatically. The management program then generates the Curie content by isotope and stores the required information for each container. As the Container Information File is created by the program, it is automatically written to disk for backup in the event of a system crash. The file can store up to 150 containers before transfer to the radwaste management program.

In practice, the operator enters the above information in the microcomputer and then initiates container processing. The Central Processor can automatically detect when a container is in position. It directs the load cell to weigh the container and pass the value into the Container Information File. Likewise, the processor directs the radiation detector to measure the count rates for the container and determines the peak and average dose rates.

The program releases the container and waits for the operator to feed the next one. It assigns a unique container identification number and directs that the weight and dose rates be taken and stored on the information file. The process is continued until the operator terminates the session. The Container Information File can then be stored, printed or passed to the Prime 450 and the radwaste management program run automatically. Shipping papers are printed by the printer when requested by the operator. Any or all required shipping papers generated by the radwaste management program may be printed out on this printer whether the data was generated by this system or elsewhere.

Bagged Waste Monitor Interface

The Central Processor program is designed to retrieve data from the NNC WCM-10 Bagged Waste Monitor. It processes the Curie content, package serial number and gross weight of each bag measured. It automatically stores the following information for each bag.

1) Curie assay
2) Accept/reject result
3) Weight
4) Specific activity
5) Serial number
6) Date/time

The program can also store only the data for bags below the reject activity and throw out all bag numbers containing radiation as they will require processing by radwaste.

CONCLUSION

The computer software is in use at the Sequoyah Nuclear Plant. The barrel counter has been manufactured and delivered to the plant and is awaiting installation.