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RADIATION DOSIMETRY DATA MANAGEMENT USING VAX C, FMS, RMS, DCL, AND ORACLE

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Abstract

The External Dosimetry Badge System was developed to support the radiation protection program at Los Alamos National Laboratory. The radiation protection program is responsible for monitoring external radiation exposures to approximately 7,500 Laboratory employees, visitors and contractors each month. External radiation exposure is measured using thermoluminescent dosimeters (TLDs). The system is used to control the assembly and distribution of TLD badges. The system monitors badge return and disassembly at the end of each month, and analyzes the TLDs to determine individual radiation exposure levels. Results are reported and stored in a database designed to maintain detailed individual exposure records. The system maintains a complete history of annual summaries for external radiation exposures. The system is user-friendly with user prompts, menus, and extensive help functions. The completely menu-driven system uses VAX C, VAX Forms Management System, VMS Record Management Services, VMS Digital Command Language, and the Oracle Relational Database Management System. Design and development issues faced, and methods and techniques used in developing the system will be described. Topics discussed include consistent user interface design approaches, considerations for using VAX/VMS programming tools versus Oracle development tools to develop and implement the application, and overall system benefits.
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I. Introduction

The Health, Safety, and Environment Division's Radiation Protection Group at Los Alamos National Laboratory is responsible for maintaining a radiation protection program. As an integral part of this program, the Radiation Protection Measurements Section of the Radiation Protection Group monitors exposure to external radiation for all Laboratory employees, contractors, and visitors. The measurement method uses thermoluminescent dosimeter (TLD) cards issued in badges to the monitored individuals. The thermoluminescent dosimeter cards contain chips made from a crystalline material, lithium fluoride. Lithium fluoride, when irradiated by ionizing radiations, stores some of the absorbed energy in the crystal lattice. If the lithium fluoride is subsequently heated, some of the stored energy is released as light, which can be detected and measured. The amount of measured light is proportional to the absorbed radiation, thus the amount of radiation absorbed by a monitored individual can be estimated.

The requirement is to design and develop a system to control the assembly and distribution of the TLD badges, monitor badge return and disassembly, analyze the TLD's to determine individual radiation exposure levels, and report and store the results in a database designed to maintain detailed individual exposure records. This report will describe: 1) the problems with the current system and the need for a new application, 2) the methodology used to solve the problem, 3) why the particular methodology was chosen, and 4) what was learned from this approach.

II. Problem Statement

The original hardware configuration consisted of a PDP 11/34a with 256 Kb MOS memory. The peripheral devices included a RP06, 176 Mb disk, a TE16 magnetic tape drive, two RK05 1.2 Mb disks, a LP11 line printer, a RX02 flexible disk drive, and a CR11 card reader. Currently a RA82 622 Mb disk and a RL02 10.4 Mb disk have replaced the original RP06 and RK05 disks. A LN01 laser printer and a RA80 121 Mb disk have been added to the system. The system also includes two Monarch bar code scanners and a Monarch bar code label printer used in the badge assembly and disassembly processes to identify the badge recipient and

associate the exposure with the monitored individual. The system software includes the RSX-11M Version 4.2 Update E operating system, FORTRAN 77, SORT 11, and DATATRIEVE.

The radiation protection program is responsible for monitoring external radiation exposures to approximately 7,500 Laboratory employees, contractors, and visitors each month. The current system was designed and developed during the late 1970's with implementation beginning in 1979. The current TLD badge processing production system processes, calculates, and reports radiation exposures using programs written in FORTRAN and MACRO-11. A personnel system is maintained using DATATRIEVE. Results are maintained using a FILES-11 file management system.

Several reasons demonstrate the need for a new system to meet current requirements for a TLD badge processing production system. The current system hardware is approaching the useful lifetime limit, and has high maintenance and repair costs. With improvements in hardware technology, more capabilities have become available. Hardware and software support for the PDP 11 is becoming increasingly difficult to obtain. Inadequate system software documentation make the current system difficult to maintain and modify. System modification is necessary to respond to changing system requirements. The system must be able to adapt to changes in system algorithms gained through operating experience, changes in reporting requirements promulgated by the Department of Energy, changes in the radiation protection program, and changes in hardware technology to implement new peripheral upgrades. With a twelve year system operating history, several useful features have been identified that are not easily implemented in the current system. The current user interface requires the operator to manually initiate system program execution, provide file specification information during processing, and maintain file name and version information during the monthly production cycle. A new menu-based user interface would reduce operator intervention and improve system efficiency. Several needed requirements indicate the necessity to develop a new application to support the external radiation monitoring program: 1) the need to take advantage of new hardware technology reducing maintenance costs and improving performance, 2) the need to improve system documentation simplifying system maintenance and modification, and 3) the need to improve the user interface, using screen management tools, increasing production efficiency.

III. Methodology - This is what was done

The External Dosimetry Badge System (EDBS) was designed and developed to solve problems associated with the current TLD badge processing system. The EDBS executes entirely on a Digital Equipment Corporation VAX 6220 using the VAX/VMS Version 5.3 operating system. The system is completely menu driven and uses the VAX C programming language, VAX Forms Management System (FMS), VAX Record Management Services (RMS), Digital Command Language (DCL), and the Oracle relational database management system. The system also uses improved bar code scanners, Intermec Model 9570, and bar code printer, Imtec Model 2400 Printer/Laminator. The system is used to control the assembly and distribution of TLD badges on a quarterly or monthly basis, and to monitor the return of TLD badges. The system is used to analyze badge results and calculate external radiation exposures. The system allows the Radiation Protection Group to maintain a complete history of annual summaries for external radiation exposures received at the Laboratory. In addition to the current year's external dosimetry detail data, the system allows a minimum of three year's detailed data to remain resident in the database. The system provides the ability to archive and purge detail data, beyond the three year minimum, on a calendar year basis. The purged data is moved to permanent storage to be retained indefinitely. The system provides the ability to archive to permanent storage and purge all data for individuals who have had no system activity for at least ten years. The system provides extensive reporting capability to meet reporting requirements. The system interfaces with a separate personnel system to obtain necessary personnel information on monitored individuals and does not maintain its own personnel data. The system is designed to allow a portion of the system to be loaded and executed on another VAX. System processes are performed by selecting options from a formatted menu. Users do not instruct the operating system to load and execute a specific program and manually supply input/output file information during processing. Some phases of the data acquisition process can be performed concurrently reducing overall system operation time without system degradation.

IV. Results - This is why it was done

The Health, Safety, and Environment Division selected Oracle as the relational database management system standard for all Division database systems. The VAX 6220 is a Division computing resource purchased and installed in 1988. The availability of the VAX 6220 and Oracle, as existing computer resources with no cost to the Radiation Protection Group, was a considerable factor in the decision to use them. The VAX/VMS operating system provides a wide range of computer alternatives by taking advantage of the VAX architecture compatibilities and product availability. Using VAX/VMS and associated layered products as system tools in combination with Oracle was selected over an entirely Oracle based system for a number of reasons. Evaluation and analysis of TLD badge results requires a third generation programming language to implement the scientific algorithms. External radiation exposure calculations for monitored individuals are more easily accomplished with a programming language. Using a combination of DCL and FMS, allows the development of a detailed menu system, while keeping operator requirements simple and data entry screens consistent. Using VAX/VMS and layered products allows a significant portion of the system to be transferred to another VAX system, increasing system portability and reducing the impact on the production system of major computer downtime. Using Oracle as a relational database management system for the final repository for TLD badge results, increases accessibility to data and reduces the number of data files currently maintained in the file management system. Finally, EDBS is the first step in a major effort within the Radiation Protection Group toward an integrated system for maintaining external and internal exposure information in a central location.

V. Discussion and Conclusions - What was learned

A comparison of the Oracle product SQLFORMS with a VAX C and FMS combination to develop system screens indicates advantages and disadvantages for each. Oracle's SQLFORMS provides a faster development environment, reducing programming time by half. However, SQLFORMS has a slower processing performance and a user interface that is difficult to use. The user interface provides too much flexibility with

key functions requiring the programmer to redefine user key functions to reduce confusion and user errors. In summation, SQLFORMS is easy to program, but difficult for the novice user to use. The combination of VAX C with embedded SQL and FMS has improved performance, provides superior analysis and statistical capabilities for exposure evaluations. However, the VAX C and RMS interface is difficult for the programmer to use, particularly setting up the control blocks necessary to interact with the files and FMS. Oracle's SQL ReportWriter is not a satisfactory product for preparing the statistical or analysis reports required by the system; it is best suited for reporting strictly information contained in the database fields. Statistical reporting is handled more readily using VAX C. Finally, in a system of this magnitude and complexity, an automated data processing professional with system design and programming experience is required.

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