Collection and Control Of Tritium Bioassay Samples At Pantex

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CONF-9211116--9

DE93 009922

Pantex is the final assembly/disassembly point for U.S. nuclear weapons. It is operated under a contract between the Department of Energy (DOE) and Mason & Hanger. Battelle Pantex, a subcontractor to Mason and Hanger, is responsible for environment, safety and health issues. Due to the nature of the work at the site, there exists the possibility of internal exposure from tritium. The Pantex internal dosimetry section monitors radiation workers once a month for tritium exposure. In order to manage collection and control of the bioassay specimens efficiently, a bar code system for collection of samples was developed and implemented to speed up the process and decrease the number of errors probable when transferring data. In the past, all the bioassay data from samples were entered manually into a computer database. Transferring the bioassay data from the liquid scintillation counter to each individual's dosimetry record required as much as two weeks of concentrated effort.

Each month a collection station for urine specimens is set-up in a strategic location. The station is operational before 7:00 a.m. to catch as many people as possible and to keep the number of "delinquents" to a minimum. The technicians may operate the collection station for as long as two hours on the regularly scheduled days. Visual reminders are displayed in common areas to remind workers of their responsibility to submit a specimen.

Pantex uses a Telxon* BCM-6 charged coupled scanner with a Telxon PTC-701 interface controller. The Telxon controller reads code 3 of 9 and stores the data in American Standard Code for Information Interchange (ASCII) format. The bar code number on each employee's identification badge is used to expedite the collection and control process. A chain of custody seal is completed and placed over the specimen cup by the worker. Then, the bar code on the badge is scanned when the employee hands over the urine specimen to the technician. The specimen is numbered by the technician and placed in the collection tray. Labels with the bar code symbol for blanks and spikes are placed over the collection tray positions and disseminated throughout the batch of samples. This allows the computerized record keeping sequence to include quality control samples that are not incorporated into the sample batch until the actual analysis process. When all specimens are collected for the batch, specimens are taken to the lab for analysis. An average "batch" of samples may vary from one hundred fifty specimens to three hundred specimens including all quality assurance samples. Approximately 450 workers are on the tritium bioassay list and are analyzed each month. A quality control checklist is completed by physically checking each sample and recording badge number, vial number, reason code, and work location. Data from the controller device is transferred in ASCII format onto a floppy disc, and given a file name with a numbering system identifying date of analysis, with an extension which is abbreviated to indicate a Telxon file. Using WordPerfect Text In and Out* (editing software), the bar code data is verified against the quality assurance checklist. During the quality control check, badges inadvertently scanned twice, or incorrect badge numbers can be identified quickly and corrected.

Disposable lab coats, rubber gloves, and protective eye wear are worn during the sample preparation which is performed in a fume hood. Universal precautions are observed during collection, preparation, and disposal of the samples. Ten milliliter (mL) vials of Ultima Gold* scintillation cocktail and one milliliter of urine are dispensed into a 20 milliliter vial. The vial caps are numbered and samples are prepared one at a time to prevent cross contamination. A electronic microliter pipette developed by RAININ* instruments is used for accuracy and reproducibility. Calibrated pipet tips are used for additional quality assurance.

A background urine sample is prepared by mixing urine from persons with no previous exposure to tritium, then pipetting a 1 mL aliquot of this composite urine into 10 mL of Ultima Gold scintillation fluor. The count time for the composite urine is ten minutes per measurement with a total of ten measurements. The average of these background counts is then entered manually into the protocol for counting tritium samples. Samples are placed in the liquid scintillation counter in the following order for processing: (1) urine background (2) known reference standard (3) unknown activity sample 1 (4) unknown activity sample 2. Five percent of the samples in the "batch" are blanks and five percent are spikes. For reproducibility, five percent of the samples are analyzed in triplicate to check pipetting technique and counting statistics. The spikes used are traceable to National Institute of Standards and Technology (NIST), and are blind samples sent from Oak Ridge National Labs as part of an inter-comparison study. The second set of unknown activity samples are analyzed as additional quality assurance checks.

Each sample is counted in the liquid scintillation counter for ten minutes with the output in ASCII text format and data fields separated by commas. The raw data are transferred onto a 3.5 inch disc, and given a file name with the same prefix indicating analysis date, however, the extension number identifies the LSC that is used. The parameters for the liquid scintillation counter include sample number, vial number, time, cpm, dpm, tSIE, luminescence flag, microcuries/liter, % 2 Sigma (%2S), and efficiency. The raw data file is then imported into a QUATTRO PRO* spreadsheet. Unnecessary columns transferred from the raw data of the LSC are reviewed, then deleted from the spreadsheet file. The only columns necessary which are recorded on the final report are dpm/mL, estimated error (%2S), and concentration (microcuries/liter).

Next, the bar code data stored in the controller device is imported into a QUATTRO PRO spreadsheet in ASCII format. After both sets of data are imported into the spreadsheet, columns are added to list a work location and reason code for submitting sample. This information is entered manually using the quality assurance checklist.

Visual verification of the merged data is completed to ensure that the liquid scintillation data merged properly with the bar code data. Vial numbers from the LSC are compared with vial numbers from the bar code data and cross referenced to the quality assurance checklist. This information is then stored in a file named with the prefix and extension indicating a complete data file. Raw data not included in the written report for the dosimetry files are stored in the LSC files, and Telxon files.

Records of the data from quality control samples from each of the two vendors are organized and retained for reporting and trending purposes. Quality control data are moved to the bottom of the complete data file by using a macro to search for quality control samples such as blanks and spikes. The Telxon data merged with the LSC data along with the reason codes and work locations are printed to a diskette. The file name extension indicates a merged file. This newly named file (the merged data file) does not include the quality control data. The merged data file is then transferred into the INGRES relational management system via a Pantex developed application called DORMS (Dosimetry Records Management System). DORMS matches badge numbers to employee names to create a finished report and enters the raw data for each person into their individual dosimetry record. An additional element of flexibility in DORMS is its ability to match bar code input against a master list to produce a summary of names of persons who did not submit a specimen. In so doing, the program prints a reminder memo addressed to each "delinquent" name.

Subsequently solved problems that arose occurred: 1) during the actual scanning process, 2) when the format from the merged spreadsheet file was transferred to the INGRES file, and, 3) during importation of various pieces of information into the QUATTRO PRO data file. For example, in 2) above, a standard format for columns and spaces was established enabling the DORMS database to assign the data to their correct fields.

This newly developed system that utilizes bar coding and computerized data entry and generation of reports has reduced significantly the time required to produce a summary report from two weeks to two days or less.