ABSTRACT

Statistical Process Control (SPC) can be described as a systematic method for improving the quality of production processes by analyzing, quantifying, and classifying the variation of processes with the goal of controlling and reducing the variation. It is often difficult to successfully implement and benefit from SPC in a production environment due to problems such as untimely feedback of critical process changes, seemingly unmanageable amounts of data, and lack of training in SPC methodology. The implementation of user-friendly menu systems created using SAS software can be effective in eliminating these problems.

This paper addresses a real-life SPC application encountered at the Rocky Flats Nuclear Weapons Plant that was solved using SAS/AF® and SAS/QC® software under the VMS operating system. Presented is a description of the application, a discussion of the development stages involved with the project, and an overview of additional applications developed for the user.

INTRODUCTION

The Rocky Flats Plant, operated under a contract with the United States Department of Energy by EG&G Corporation, is a major manufacturing facility employing over 7000 people. The Health Science (HS) Labs at the EG&G plant maintain a large database containing information on the radiation levels in air and water samples taken at fixed plant locations as well as bioassay samples. A total of 128 alpha spectrometer detectors located in a central laboratory are used to measure the radiation levels in the samples. The goal is to accurately test for radiation levels exceeding those naturally occurring or expected in nature. In order to do this background radiation levels must be characterized and each detector calibrated accurately to account for the background radiation. The distribution of background radiation measurements is characterized by measuring background in an empty chamber for twenty-four hours on a weekly basis. Each week the total measurement background (attribute data) and detector efficiency (variable data) are recorded. The mean radiation levels in the measurements are assumed to be constant, therefore any abnormal variation is characterized as detector related error. Unexpected changes in the measurements (special causes) such as trends, shifts, or outliers leads to an evaluation of the suspect detector.

A user-friendly menu system developed using SAS/AF® software was instrumental in implementing an effective SPC program for monitoring alpha detector performance.

The menu allows a user with limited knowledge of the SAS programming language to analyze both background and efficiency data for each of the 128 detectors and immediately receive feedback on out-of-control detectors. In general, it is inefficient to generate plots of total background and efficiency for each detector on a weekly basis. However, utilizing the menu system saves users time and resources because they evaluate only those detectors which signal.

STARTING OUT

Once SAS 6.06 had been installed on the plant’s main VAX cluster, the first job in the development process was to become familiar with SAS/SCL® (Screen Control Language). The SAS Screen Control Language reference manual was a valuable resource in learning the software. As stated in the reference manual, SCL is a collection of functions, statements, and routines used to write programs for applications built with SAS/AF® or SAS/FSP® software in release 6.06 of the SAS system. SCL controls the flow of programs and screens in AF and FSP applications.

After learning SAS/SCL® and an initial period of experimentation with SAS/AF® software, the development of a time-saving, user-friendly menu system for monitoring detector performance began.

Figure 1

MAIN MENU

1 - TUTORIAL
2 - DATA MANAGEMENT
3 - HS LABS QUALITY CONTROL APPLICATIONS
4 - STATISTICS
5 - EXIT

Figure 2

HS LABS QUALITY CONTROL APPLICATIONS

1 - UPDATE SAS DATA SET WITH ASPECOC DATA
2 - FLAG OUT-OF-CONTROL DETECTORS
3 - GENERATE EFFICIENCY CONTROL CHARTS
4 - GENERATE BACKGROUND CONTROL CHARTS
5 - GRAPHICS OUTPUT
6 - LIST ALL CURRENT GRAPHICS CATALOGS
7 - ESTABLISH HISTORICAL CONTROL LIMITS
8 - EXIT

Figures 1-2. SAS/AF® Main and HS Labs Quality Control Applications Menus.
The main menu shown in Figure 1 lists five options available to the user. Option 3, HS Labs Quality Control Applications, allows operators to perform specific tasks in the evaluation of the alpha detectors. Within the HS Labs Quality Control Menu, the user can choose from eight options listed in Figure 2.

On a weekly basis a user will typically append a flat file containing the latest detector efficiency and background measurements to an existing SAS data set by selecting option 1 of the menu shown in Figure 2. The new data is then compared to historical control limits which are periodically updated by selecting option 7. The outtable option in Proc Shewhart is used to generate control limits for detector efficiency and background counts based on a historical population of blanks. Once the files containing the new data and historical control limits are established, the user has a number of options.

Generally, the user is interested in generating a list of out-of-control detectors for a specific time frame. Option 2 allows a user to test background counts data against four special cause criteria using the CChart option in Proc Shewhart, and detector efficiency data are tested against eight special cause criteria using the XChart option. The user may then obtain a listing of the status of each detector, or a listing of only those detectors signaling as shown in Figure 3. Note that the special causes are listed for each detector.

![Figure 3](image)

**Figure 3.** Output generated when testing for special causes and out-of-control detectors.

After examining the listing shown in Figure 3, a user may choose to generate control charts for out-of-control detectors. Figure 4 shows the user input screen for generating control charts of detector efficiency. The user has the option of saving the control charts in a graphics catalog and displaying the plots using one of four template options. Graphs may be displayed on the screen or sent to an external plotting device. Figure 5 displays an example of a graphics output when template 2 is chosen for displaying two plots per page.

![Figure 4](image)

**Figure 4.** User input screen for the detector efficiency control chart option.
FIGURE 5. Graphics output from Proc Shewhart.

MENU EXPANSION

A. Applications Outside the HS Labs Area.

In addition to the content specific Health Science Labs portion of the menu, the main menu includes more general options available to system users. The Data Management Menu, shown in Figure 6, gives the user a number of options for data input and manipulation. The Statistics Menu, shown in Figure 7, allows a user to perform simple statistics procedures. These menus also serve as a foundation for future applications to meet the specific needs of users in different plant areas.


CONCLUSIONS

The menu system presented in this paper serves as an example of how SAS software can be used to simplify a seemingly overwhelming problem. By utilizing the power of SAS/AF® and SAS/QC® software, Health Sciences personnel at the Rocky Flats Plant have implemented a highly effective and easily expandable SPC program to monitor the performance of 128 alpha spectrometry detectors. The menu system allows for timely feedback on process changes, eliminates the necessity for users to know the SAS programming language, and enables the user to generate critical outputs which assist in problem solving. In addition, a considerable time savings has resulted since users now have the ability to prioritize and evaluate only those detectors which signal. More time is devoted to preventing problems rather than solving problems once they occur.

REFERENCES

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