S550
Eclipse LB

User's Manual

9231577G V3.1

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The information in this document describes the product as accurately as possible, but is subject to change without notice.

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Read Me First

Eclipse LB Database Conversion Utility

Overview

This Eclipse LB release contains a standalone database conversion utility to allow the customer the ability to migrate the data stored by Eclipse LB v1.14 and higher to the current version of Eclipse. Only the information stored within the database tables will be migrated. All other database objects such as forms, queries, reports, macros, and modules will not be migrated. Once the conversion has been completed any additional database objects can be copied from the older database to the newer database using standard Windows copy and paste methods. This utility will also give the user the option to copy the existing procedure files (*.lbd, *.xbd) to the target location specified.

Operation

During the installation two files will be copied to the Eclipse destination folder. These two files are the executable, DBCONVERT.EXE and the current Eclipse database template, ECLTEMP.MDB. This template represents the schema of the current Eclipse database. During the conversion you will be asked for a location to store the new database. This template will then be renamed into that folder with the name ECLIPSE.MDB. The conversion program will not overwrite an existing ECLIPSE.MDB file in the folder specified. If one exists in the folder specified either select a different folder or rename the existing database file. Once the conversion has finished you can always move the new converted database to the appropriate location.

To run the conversion program, locate the DBCONVERT.EXE file using the Windows Explorer and double-click on the file. Remember, this utility will be located in the same folder that you installed the current Eclipse LB program.

When the application loads Figure 1 will appear.

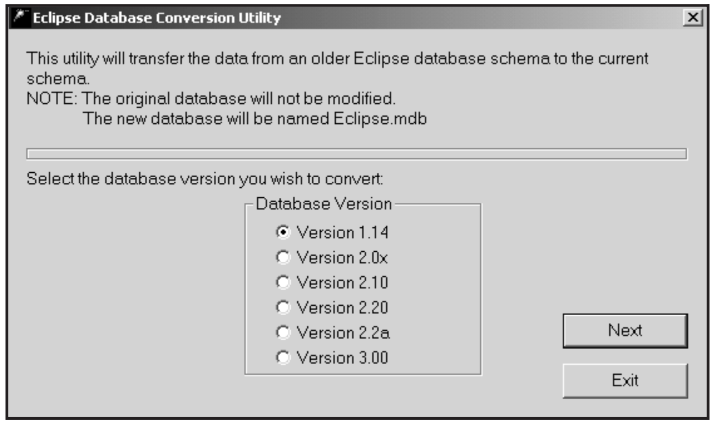


Figure 1 Selecting the Database Version to Convert

Select the appropriate option for your database and select the **Next** button. Enter in the name of the database you choose to convert, Figure 2.

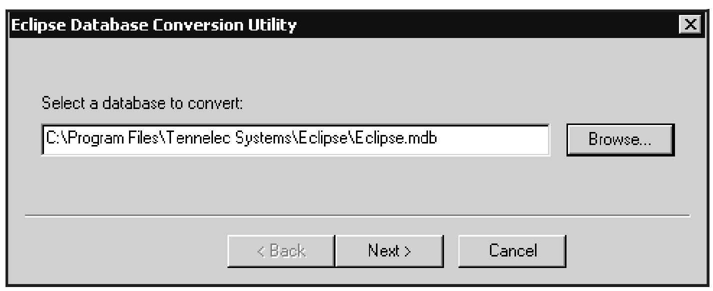


Figure 2 Selecting the Database File to Convert

Either type in the full path and filename or select the **Browse** button to locate the file. Once the file is selected click **Next**. If the database specified can not be identified as the appropriate version you are trying to convert, an error message is displayed and you are asked to make a new selection.

Next enter the location to store the new converted database, Figure 3.

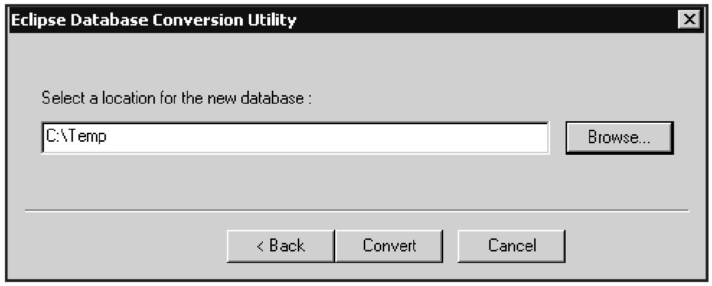


Figure 3 Selecting the New Database Location

Either type in the full path or select the **Browse** button to locate the folder. Once folder location selected press the **Convert** button. If the folder already contains an ECLIPSE.MDB file an error message is displayed. You will have to make a new selection or rename the existing file before continuing.

After selecting the **Convert** button the following message is displayed, Figure 4.

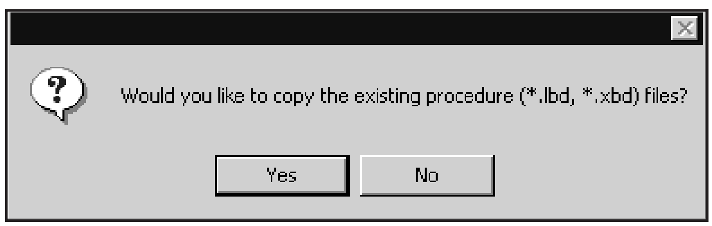


Figure 4 Converting the Procedure Files

If you would like use the existing procedures with the converted database select *Yes*, otherwise select *No*. This will copy the existing files with the extension .lbd and .xbd to the location previously specified. If there is an error copying a file then a message is displayed detailing the error and that file will be skipped. The progress dialog below will list all those files successfully copied.

When the conversion begins a progress dialog will be displayed listing each table in the database as it is converted. See Figure 5.

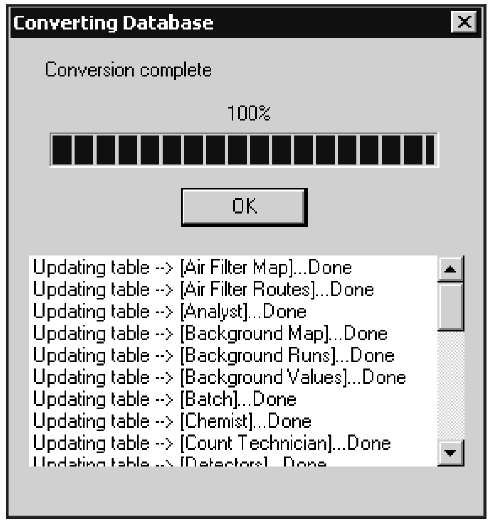


Figure 5 Database Conversion
Progress Dialog

Selecting the **Cancel** button will display a message box asking you if you want to cancel the conversion. Select *Yes* to stop the conversion process or *No* to continue converting the database.

Once the conversion is complete, selecting the **Ok** button will return you to the initial startup screen.

Select the **Exit** button to terminate the database conversion utility.

Important Notes

- Eclipse LB v2.0x refers to versions 2.00 through 2.0A. Such as v2.01, v2.02, …, 2.0A

- This utility in no way modifies the existing input Eclipse database. All records from the older tables are simply copied into the current Eclipse database.

- Any additional database objects such as forms, queries, reports, macros, and modules that may have been added and/or customized in the older database will not be migrated using this utility.

- This utility must be run immediately after installation of Eclipse LB if data migration is desired. It will *not* merge records from an older database, with existing records created with this version of the Eclipse database.

1. Introduction

Welcome to Eclipse LB Software

This manual introduces you to Eclipse LB software and the Tennelec Series 5. It presents all of the information you will need to operate the system and analyze your data. It shows you how to do the most common operations, provides you with tips, and points you to the many new features that are part of Eclipse LB. Some information in this user's manual covers hardware information unique for specific Tennelec low background counting systems including those that have been upgraded to work with Eclipse. Specific hardware related information will be contained in the installation manual that was originally provided with the system.

About this Manual

This manual contains the following chapters and appendices:

Chapter 1, *Introduction* (this chapter), this chapter is an introduction to the manual.

Chapter 2, *Getting Started*, provides information about how to install the software onto your computer.

Chapter 3, *Software Environment*, describes the appearance and function of the main Eclipse LB window.

Chapter 4, *Setting Up to Count Samples*, describes how to calibrate the system.

Chapter 5, *Creating System Counting Procedures*, describes how to use the Procedure Manager to create calibration and sample counting procedures.

Chapter 6, *Archiving Batch Data*, describes how to create, view, and delete archived batch data.

Chapter 7, *DB Utilities*, describes how to use the DB Utilities to add/edit devices, standards/nuclides, as well as how to edit plateaus, background averages, efficiency averages, spillover average, and attenuation averages.

Chapter 8, *Sample Manager*, describes how to use the Sample Manger to enter sample information needed for analysis of that sample.

Chapter 9, *Eclipse QC Chart Programs*, describes the how to use the QC Chart Program.

Chapter 10, *Sequence Manager*, describes how to use the Sequence Manager to define a series of procedures to run in a specified order.

Chapter 11, *Security Setup*, how the System Administrator can create and maintain a database of users, their group assignments and the security objects each group can access.

Chapter 12, *System Overview*, describes hardware specifics, focused on the Series 5.

Chapter 13, *Upgraded System Instructions*, contains information about how to use Eclipse LB software with older systems that employ both NIM and non-NIM electronics.

Chapter 14, *Gas Management System*, provides information on Gas Stat and other gas conservation features in the Series 5 systems.

Chapter 15, *Gas Flow Proportional Counting*, presents an introduction to the theory and practice of using gas flow proportional detectors for alpha and beta measurements.

Chapter 16, *Troubleshooting*, answers questions about installation, gas flow, plateau, discriminator, background, efficiency, attenuation and data reasonability problems that are occasionally encountered.

Appendix A, *References*, provides a list of references.

Appendix B, *Glossary of Terms*, provides definitions of technical, nuclear, computer and software terms used in this manual.

Typographic Conventions

Windows Commands

Windows commands are shown in bold type (**View**).

Key Names

This manual shows the names of keyboard keys as they usually appear on the keyboard and are seen in small capital letters (for example, ESC, ENTER, CTRL).

Key Combinations

A plus sign (+) between two key names means that these keys must be pressed at the same time. For example, Press “ALT+ESC” means that you should press the ALT key and hold it down while you press the ESC key.

User Entries

Text you are expected to type in shown in `Courier` (typewriter style) type.

Titles

Title of books and of manual chapters are shown in *italics*; titles of manual sections are enclosed in “quotes”.

Getting Help

The Tennelec Eclipse LB software program contains an easy to use help system to guide you through the learning process of the software. You can get help for any Eclipse function by pressing the F1 key or by selecting **Help** from the Eclipse Menu Bar and then **Help Topics**.

2. Getting Started

Pre-Configured Software

Factory supplied computer systems are normally configured with the IEEE interface and Eclipse LB software pre-installed and ready to run. It will not be necessary to load the software again unless updating versions, replacing the personal computer (PC), or repairing a PC hardware or software failure. It is recommended that the hard drive be backed-up regularly.

IEEE Interface and Driver Software Installation

In the event that Canberra does not supply the computer, it will be necessary for the Field Service Engineer or the end user to install the IEEE interface.

USB Type Interface

If the IEEE Interface is of the “USB” type (like the National Instruments GPIB-USB-B), follow the directions provided by the manufacture for installation and configuration of the driver software.

After the IEEE driver software is installed on the computer, follow the manufacture’s instructions for connecting the interface to the computer.

Plug and Play Type Interface

If the IEEE Interface is of the “Plug and Play” type (like the National Instruments PCI-GPIB), then the card does not require any jumpers or DIP switches to be configured before the card is installed in the computer.

Follow the card manufactures instructions for installing the card into the computer.

After the IEEE Card is installed in the computer, follow the interface manufactures instructions for installing the card into the computer.

Jumper or DIP Switch Type Cards

If the IEEE Card is of the older style with jumpers or DIP switches (like the National Instruments GPIB-PCII/IIA), then the card should be configured before it is installed in the computer. Configure the card as follows:

1. Set the National Instruments PCIIA card switches and jumpers (Figure 6). Install the card in the computer using the National Instruments Installation procedure.

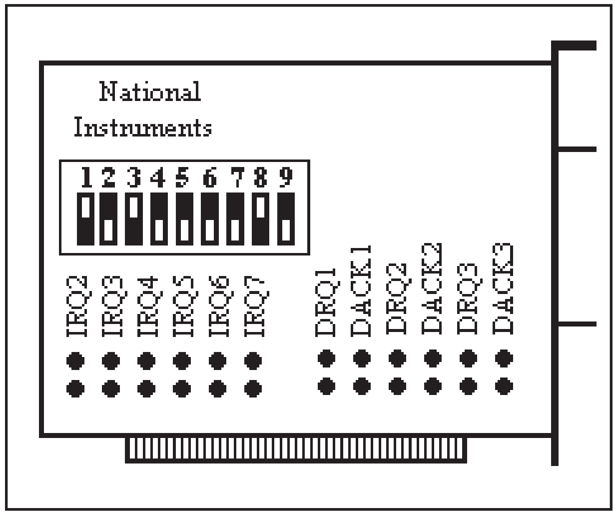


Figure 6 IEEE Card Settings

2. Locate the Windows installation disks included with the National Instruments IEEE-488 card. Insert disk 1 into the disk drive. Click the **Start** button and then point to **Settings**.

3. In the Control panel, double-click the *Add/Remove Programs* icon. Select **Install**. Follow Instructions on screen.

4. Windows will search the computer for the installation program. If the field labeled “Command line for installation program:” is blank or includes the incorrect filename, then type `[D]:Setup`. Choose full installation when prompted. When finished, remove the disk from the disk drive.

5. Locate the Compatibility disks included with the National Instruments card. Insert into the disk drive. Click the **Start** button and then point to **Settings**.

6. In the Control panel, double-click *Add/Remove Programs*. Select **Install**. Follow instructions on screen. If the field labeled “Command line for installation program:" is blank or includes the incorrect filename, then type `[D]:Setup`.

7. Windows will search the computer for the installation program. If the field labeled “Command line for installation program:” is blank or includes the incorrect filename, then type `[D]:Setup`. When asked for the subdirectory where the installed program should be placed, choose “Compatibility.” When finished, remove the disk from the disk drive.

8. Run the Windows Explorer program from the Start button. From the **View** menu, choose **Options**. Select “Show all files” then clear “Hide MS-DOS file extension for files that are registered". Click **OK**.

9. On the Explorer screen, locate the Windows folder. Double click it. Locate the System folder. Double click it.

10. Click the “Up one level” button twice. Double-click on the Compatibility folder. Click once on the file GPIB-16.DLL. While holding the CTRL button, click once on the file GPIB-32.DLL. While continuing to hold the CTRL button, drag the highlighted files to the [D:]Windows\System folder. Release the mouse and the CTRL button simultaneously.

11. If everything was performed in the correct order, a message should appear asking whether to overwrite existing files because they already exist. Answer yes for both files.

12. Double-click the GPIB icon on the control panel. Select GPIB0 and click **Configure**. The hardware settings should be as follows:

    Use this Board = Yes

    Base I/O Address = 0x02e1

    Interrupt Level = None

    DMA Channel = None

    Timing = 500nsec

Software Installation

The Eclipse LB installation program will automatically execute when the CD is placed in the CD-ROM drive and the auto-run feature of Windows is enabled.

Computer Requirements

The minimum specification for the computer system include the following:

- Pentium® Class 200 MHz processor or faster
- 32 MB RAM
- 850 MB or larger HD with at least 50 MB free
- SVGA monitor with a minimum or 800 x 600 pixel resolution and 256 colors
- Microsoft® Windows NT® V4.0, Windows 2000 or Windows XP
- 4X or faster CD ROM Drive

In addition, the following optional hardware and software is recommended:

- Microsoft® Access 97/2000
- Crystal Reports® V7.0 or higher (if custom reports are required)
- pcAnywhere™ 32 for Remote Link
- 28.8 KBPS or faster modem
- Iomega ZIP drive or other high capacity backup media
- Un-interruptible Power Supply

First Time Installation

When the Eclipse LB installation is run for the first time on a computer it will take you through a series of screens. Once the Eclipse LB CD has been inserted into the CD-ROM drive, the InstallShield Wizard will install the components necessary to perform the system software installation.

Once the InstallShield Wizard is installed, the Welcome screen (Figure 7) appears. Click **Next** to continue or **Cancel** to exit this installation.

Figure 7 Welcome Screen

The License Agreement (Figure 8) is next and you must click on the *Yes*, accepting these terms, in order to continue with the installation.

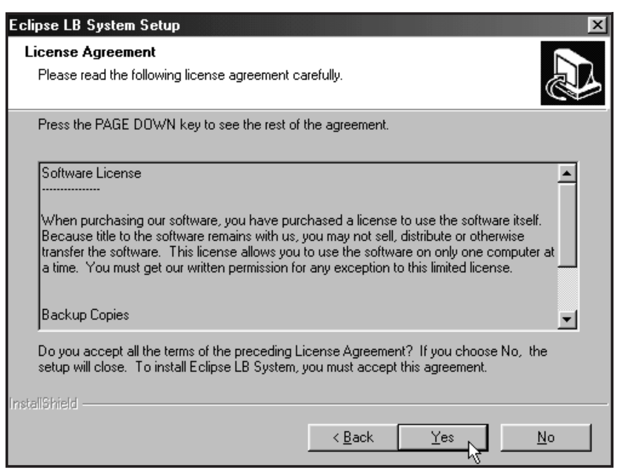


Figure 8 License Agreement Screen

Next is the Information screen displaying the Eclipse LB Release Notes. You may right mouse click on this page to **Select All** and then copy this document in order to paste it into another document for printing. Click **Next** to continue, **Back** to return to the previous screen or **Cancel** to exit this installation.

The Customer Information screen (Figure 9) is displayed next. Once completed, click on the **Next** button to continue, the **Back** button to return to the previous screen or the **Cancel** button to exit this installation.

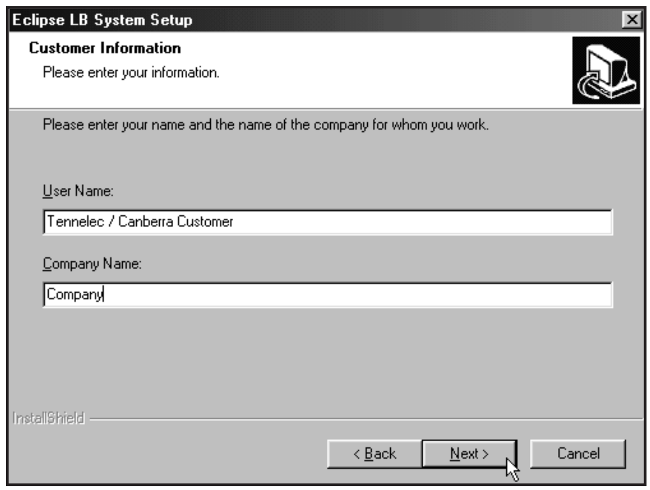


Figure 9 Customer Information Screen

The Choose Destination Location screen (Figure 10) is next and lists the default folder for Eclipse. You may click on **Browse...** to select a different location for Eclipse LB folder or **Next** to accept the default location for this folder. Click **Back** to return to the previous screen or **Cancel** to exit this installation.

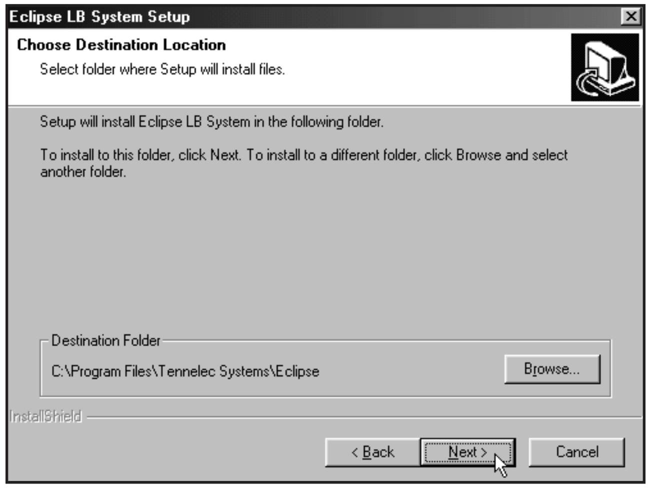


Figure 10 Choose Destination Location Screen

The Select Components screen (Figure 11) is next and provides you with the ability to select additional components for installation. A description is provided on the right side of this screen for the highlighted selection. The total space required for the items selected is listed at the bottom of the screen as well as the total space available on the computer hard drive. Once all choices have been selected, click **Next** to continue, **Back** to return to the previous screen or **Cancel** to exit this installation.

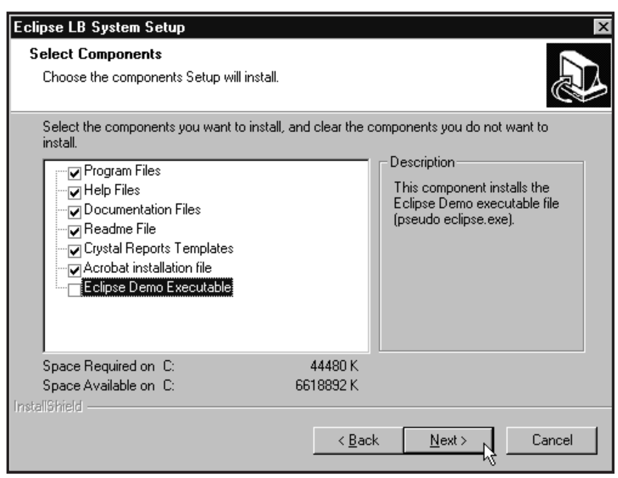


Figure 11 Select Components Screen

The Select Program Folder screen (Figure 12) is next and lists Eclipse as the name of the folder for the installed files. You may accept this name or create a new name. Once this choice has been made, click **Next** to continue, **Back** to return to the previous screen or **Cancel** to exit this installation.

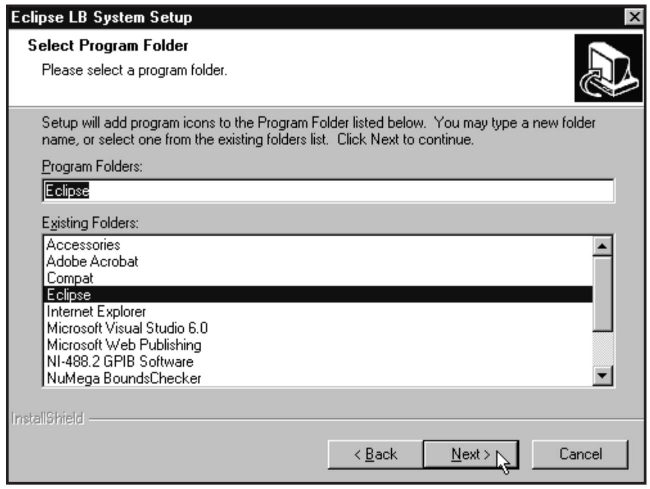
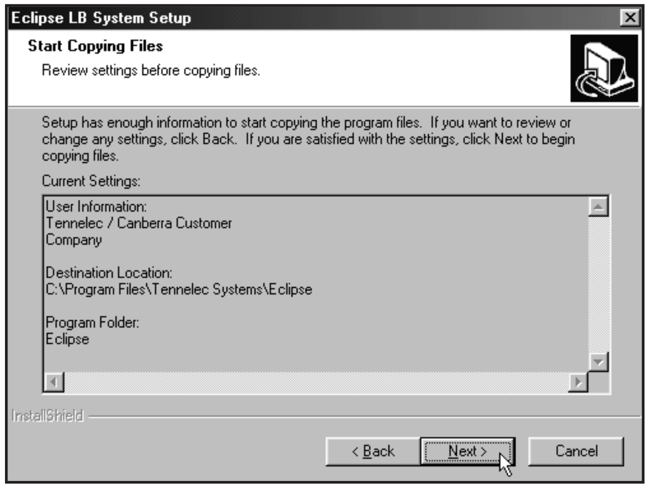
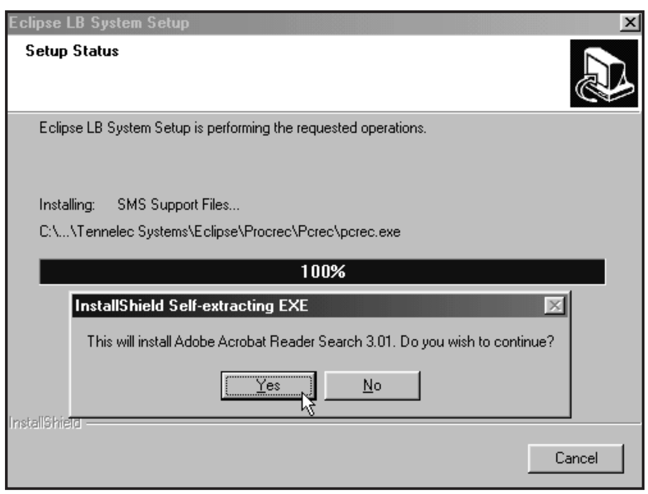


Figure 12 Select Program Folder Screen

The Start Copying Files screen (Figure 13) is next displaying a review of the User Information, Destination Location and Program Folder name. If everything is correct, click **Next** to begin copying files to complete the installation of Eclipse LB. You can click **Back** make changes or **Cancel** to exit this installation.


Eclipse LB System Setup
Start Copying Files
Review settings before copying files.
Setup has enough information to start copying the program files. If you want to review or change any settings, click Back. If you are satisfied with the settings, click Next to begin copying files.
Current Settings:
User Information:
Tennelec / Canberra Customer
Company
Destination Location:
C:\Program Files\Tennelec Systems\Eclipse
Program Folder:
Eclipse
InstallShield
< Back
Next >
Cancel


Eclipse LB System Setup
Setup Status
Eclipse LB System Setup is performing the requested operations.
Installing: SMS Support Files...
C:\...\Tennelec Systems\Eclipse\Procrec\Pcrec\pcrec.exe
100%
InstallShield Self-extracting EXE
This will install Adobe Acrobat Reader Search 3.01. Do you wish to continue?
Yes
No
InstallShield
Cancel

Once all files have been installed, the following screen, Eclipse LB System Setup, appears. Click **Finish** to finalize this installation of Eclipse LB.

Modify, Repair, or Remove Eclipse LB

If it becomes necessary to modify the Eclipse installation (add components not originally installed), re-install Eclipse completely, or remove all installed components of Eclipse, the InstallShield wizard will detect the existence of Eclipse LB and Figure 15 appears.

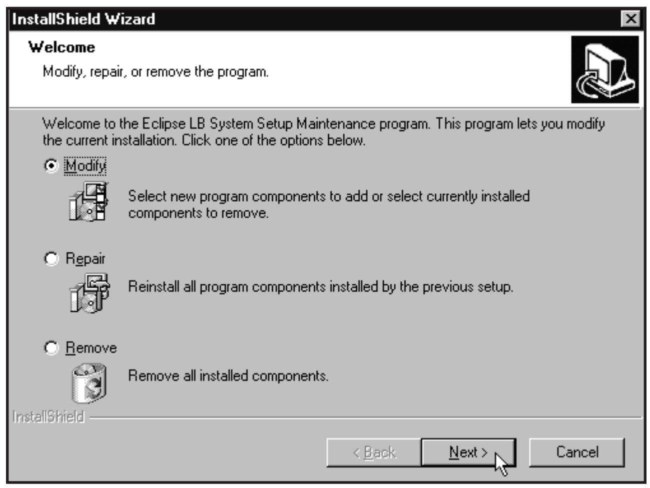


Figure 15 Modify/Repair/Remove Eclipse Installation

Selecting the *Modify* option will allow you to select components for installation that were not selected when Eclipse LB was originally installed (Figure 16).

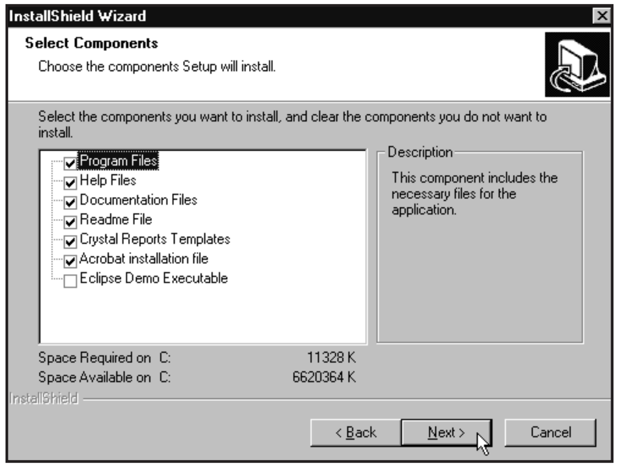


Figure 16 Choosing the Components to Install

Selecting the *Repair* option will display the Setup Status screen showing the progress of this repair installation.

Once completed, the Maintenance Complete screen is displayed. Click **Finish** to finalize the repairs to Eclipse and return to Windows desktop.

If *Remove* option is selected, you will be required to confirm this choice by clicking on **OK** (Figure 17).

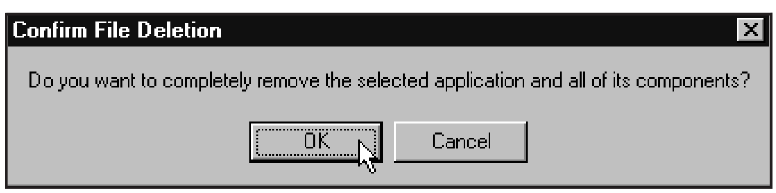


Figure 17 Removing the File

As a precaution, Eclipse LB will save the existing database, procedure files and report templates to a subfolder in the current Eclipse subdirectory. Eclipse will name this folder “Saved HHMMSS” where HHMMSS is the time of day that this action was requested. Click **OK** to continue (Figure 18).

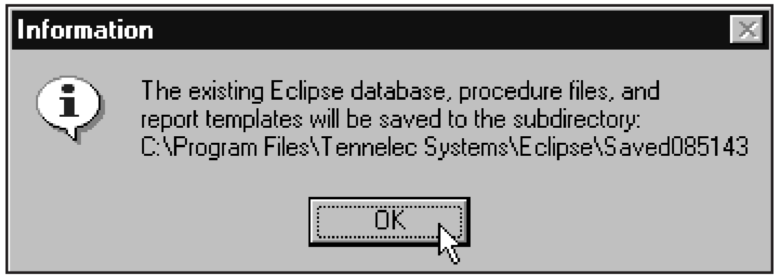


Figure 18 Saving to the Correct File Location

The next screen ask you to confirm or deny the deletion of a shared file. This message will be repeated for all shared files. Select “Don’t display this message again” and Eclipse LB will continue with this removal without further operator intervention (Figure 19).

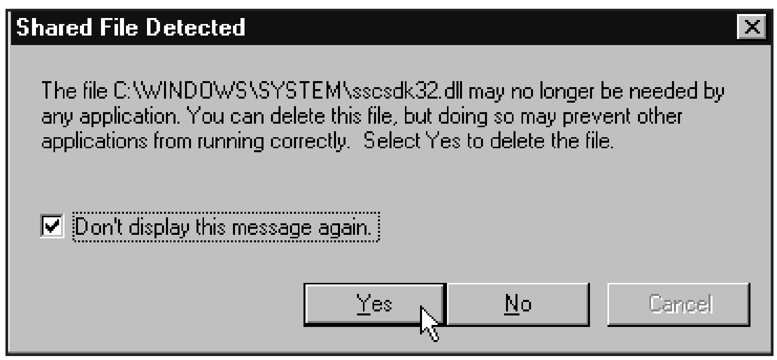


Figure 19 Confirming Shared Files

Once the removal of Eclipse LB is concluded, a Maintenance Complete screen will appear. Click **Finish** to return to Windows.

Updating Previous Versions of Eclipse

When installing Eclipse LB on a computer with an earlier version of Eclipse already installed, the installation will basically follow the same progression as a new, first time installation. When this installation reaches the Setup Status screen, a message will appear and identify the location and folder name where a copy of the existing Eclipse database, procedure files and report templates will be saved. Click **OK** to continue. Once these files have been copied and saved, Eclipse LB will convert the previous database and procedures to the current format (Figure 20).

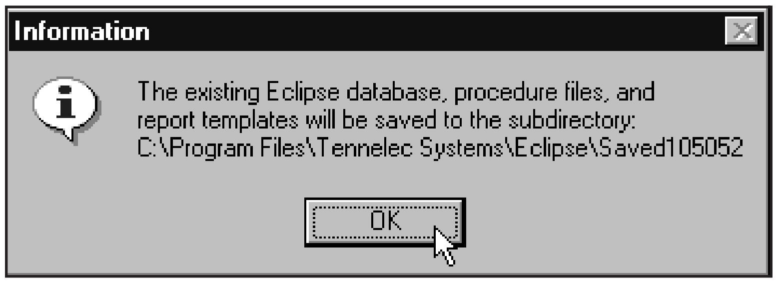


Figure 20 Saving the File Location

Upgraded Systems

Older Tennelec systems can be updated to the Eclipse software package. Please see Chapter 13, *Upgrade System*, for more information.

Starting Eclipse

Whenever Eclipse is started, an Enter Login Information screen appears. The initial screen, after installation, lists the Name as administrator with no Password. (Figure 21) Leave this login screen as it appears and click Enter. Eclipse is now fully functional with no restrictions to any features.

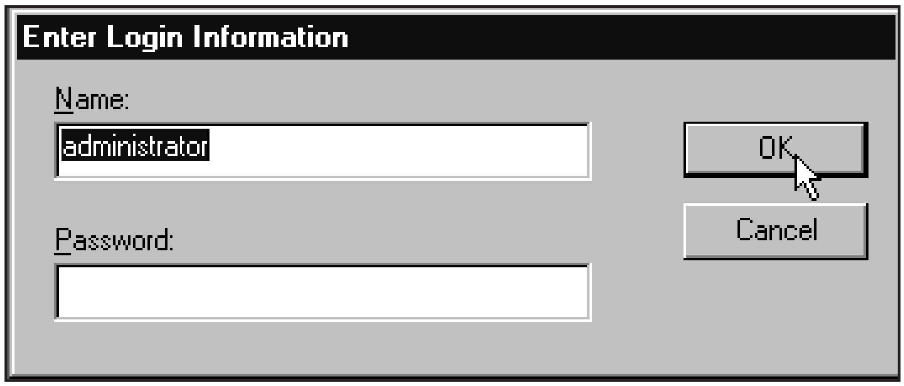


Figure 21 Entering Login Information

3. Software Environment

Eclipse LB is a powerful, flexible, and easy to use software interface for Tennelec Automatic Low Background Alpha/Beta Counting Systems. Eclipse is designed to operate Series 5 and LB5500 systems, as well as the earlier series of LB5100 and LB5500 systems previously upgraded to operate under Windows. The software is designed to address most counting applications including: health physics, nuclear power, environmental re-mediation, and radiochemistry.

Eclipse LB is designed to run under Windows NT/2000/XP. A working knowledge of proportional counting systems, Microsoft Windows and Microsoft Access will provide a good foundation for understanding Eclipse LB software. Tutorials included with Microsoft Windows and Microsoft Access are good starting places for this information. Users requiring custom reports for the output of results should also be familiar with Crystal Reports V7.0 or higher.

Users are encouraged to refresh their knowledge of nuclear decay processes, nuclear instrumentation, and counting statistics. Understanding these concepts will expedite familiarization with Eclipse LB. Good sources of information can be found in various textbooks. References for several are provided at the end of this manual.

Eclipse Main Screen

The Eclipse main screen is similar to other Windows applications. The Main screen (Figure 22) includes a Title bar, a Menu bar, a Toolbar and, at the bottom of the screen, the Status bar. Depending upon the size of the Eclipse LB window and the number of open documents, horizontal and/or vertical scroll bars may be displayed along the bottom and right borders of the windows.

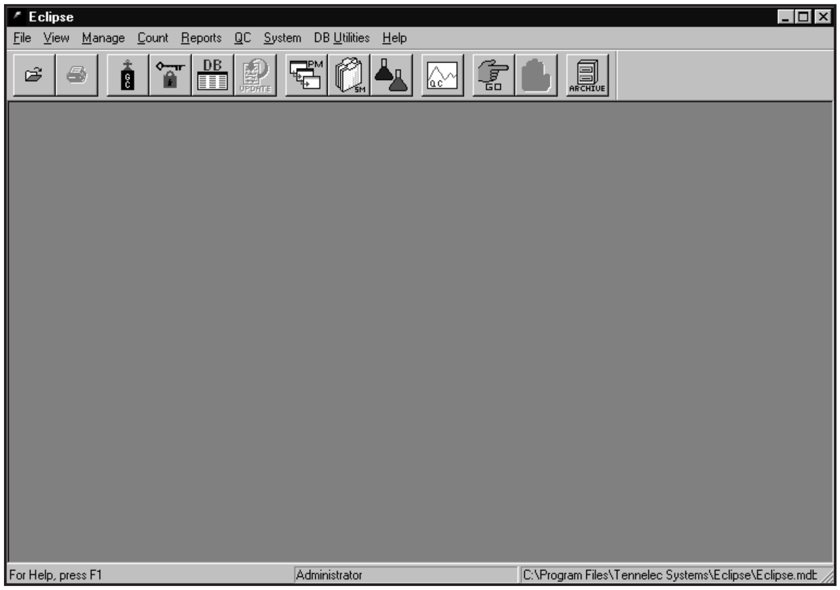


Figure 22 Eclipse Main Screen

Once a counting procedure is started or recalled, the Batch window contains four tab pages of information (Figure 23). These four pages provide a majority of the information relevant to a sample analysis.

The first tab, *Samples*, shows the results of the counting procedure. When a count is in process, the information on this page is updated approximately every 0.2 minutes.

The second tab, *Status*, displays applicable information pertaining to the count displayed and the system used for this analysis.

The third tab, *Plateau*, graphically displays the counts versus voltage of a plateau measurement.

The fourth tab, *Attenuation*, graphically displays the results of an attenuation calibration while allowing you to select the Model that best represents this data.

Samples | Status | Plateau | Attenuation

Sample ID	Carrier ID	Time (Min)	Count Rate (cpm)	Unc	Voltage (Volts)
20030129093826-A0	0	1.0	492.00	22.18	900.00
20030129093837-A0	0	1.0	510.00	22.58	930.00
20030129093838-A0	0	1.0	830.00	28.81	960.00
20030129093839-A0	0	1.0	2884.00	53.70	990.00
20030129093840-A0	0	1.0	4000.00	63.25	1020.00
20030129093841-A0	0	1.0	5340.00	73.08	1050.00
20030129093842-A0	0	1.0	7000.00	83.67	1080.00
20030129093843-A0	0	1.0	9640.00	98.18	1110.00
20030129093844-A0	0	1.0	12100.00	110.00	1140.00
20030129093845-A0	0	1.0	15070.00	122.76	1170.00
20030129093846-A0	0	1.0	19096.00	138.19	1200.00
20030129093847-A0	0	1.0	22836.00	151.12	1230.00
20030129093848-A0	0	1.0	27530.00	165.92	1260.00
20030129093849-A0	0	1.0	30766.00	175.40	1290.00
20030129093850-A0	0	1.0	33460.00	182.92	1320.00
20030129093851-A0	0	1.0	35110.00	187.38	1350.00
20030129093852-A0	0	1.0	36966.00	192.27	1380.00
20030129093853-A0	0	1.0	37186.00	192.84	1410.00
20030129093854-A0	0	1.0	36960.00	192.25	1440.00
20030129093855-A0	0	1.0	37170.00	192.80	1470.00
20030129093856-A0	0	1.0	37284.00	193.09	1500.00
20030129093857-A0	0	1.0	37203.00	192.88	1530.00
20030129093858-A0	0	1.0	37165.00	192.78	1560.00
20030129093859-A0	0	1.0	37468.00	193.57	1590.00
20030129093900-A0	0	1.0	38121.00	195.25	1620.00

Figure 23 Tab Selection

Sample data is stored in a Microsoft Access database. Eclipse LB allows you to recall any analysis, examine the acquired data, and print the results in a Crystal Reports format.

Eclipse Batch Window

From the Eclipse LB Batch Window you can be modify the Sample Display screen's size, column widths and the foreground and background colors.

To access this configuration menu, right click on the title bar of a Batch window that has been recalled or is counting. If the title bar is not displayed, the window has been maximized. To minimize the window and access the toolbar, click on the Minimize button located in the upper right hand corner of the screen.

Set Column Widths

Using the mouse, move the cursor over the column to be resized. When an arrow is displayed, adjust the column width or completely eliminate the column from view (Figure 24).

For example, a Plateau procedure can be set to display only the count rate and voltage steps (Figure 24). When the desired settings are displayed for a particular procedure, right click on the title bar of the Batch window and select **Set Column Widths** from the menu. This sample display format is now the default for all samples counted under this procedure.

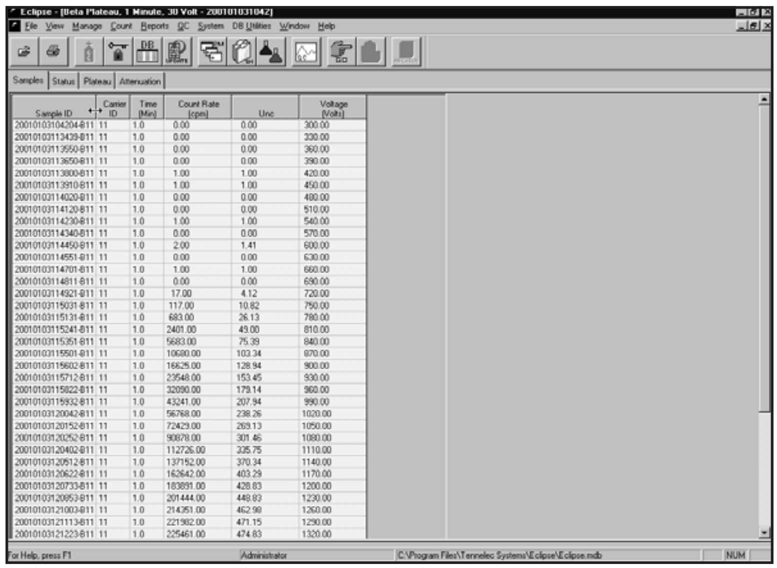


Figure 24 Setting the Column Width

Continue the steps above to customize column widths for each counting procedure.

Set Default Window Size

Using the mouse, move the cursor to the outside edge of the Sample Display screen. When an arrow is displayed, click and drag the window to change its size. To set this window size for the default for all procedures, right click on the title bar of the Batch window and select **To Current**. To set the default window size to be maximized for all procedures counted, right click the title bar of the Batch window and select **Maximum**.

Note: It is important to remember that the **Set Default Window Size** is a global setting. It is not procedure specific as the Column Width Size function.

Customize Colors

This feature will allow you to select the default foreground and background colors of the Sample Display screen as well as foreground and background colors for a selected sample in the list. To access the custom colors, right click on the title bar of the Batch window and select **Customize Colors** (Figure 25).

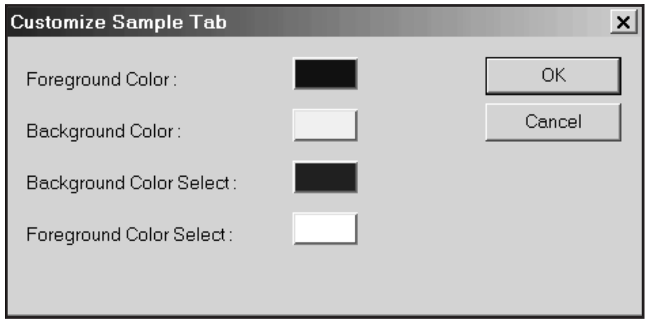


Figure 25 Selecting a Custom Color

To change a color, click on the desired box. The Color dialog box (Figure 26) will appear.

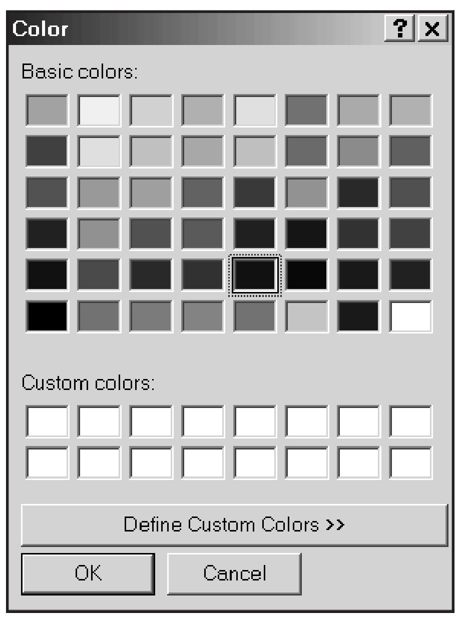


Figure 26 Changing the Color

Select the color of your choice and click **OK**. The selected color will now be the default for all counting procedures. Continue the above steps to modify colors for the remaining parameters.

Note: It is important to remember that the **Customize Colors** feature is a global setting. It is not procedure specific as the Column Width Size function.

The Title Bar

The Title Bar contains Minimize, Maximize, and Close buttons at the upper right corner of the screen depending on whether or not the Batch window is minimized or maximized. An Eclipse Icon is displayed at the upper left corner of the screen. Clicking on it will display a program menu with options to change the size and to exit the program. If a batch is being counted, the name of the Count Procedure is displayed. If a previously counted batch is being displayed, the name of the Count Procedure followed by the date and time of the analysis is displayed.

The Menu Bar

The Menu Bar provides for both mouse and keyboard operation. For keyboard operation, menu commands can be accessed by pressing the ALT key and the underlined letter of the menu command. Each menu contains related functions that can be highlighted by using the up and down arrow keys or by pressing the underlined letter of the menu function.

Using a mouse, position the pointer on the menu command and then click the left mouse button. The options of that menu command will be displayed.

File

There are several unavailable commands on the **File** menu. They will appear grayed out.

No Batch Data Displayed

With no batch data displayed, the **File** menu enables you to; recall a batch, setup the printer or exit Eclipse (Figure 27).

Figure 27 File Menu - No Batch Data

Recall Batch

Recall Batch displays the Recall Batch screen (Figure 28). To recall a batch, highlight the batch of interest and click **OK**.

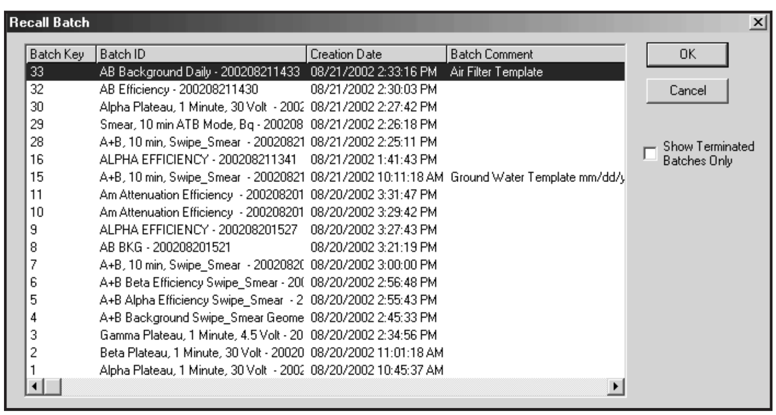


Figure 28 Recalling Previously Run Batch

If the *Show Terminated Batches Only* is selected the Recall Batch dialog box displays only those batches that were terminated by the operator or due to some system error.

Log In

This item is only avaiable when there is no user logged in to the system. Selecting it will allow a user to login.

Log Out

This item only available when a user is logged into the system. Selecting it will log the current user out of the system, disable system operation and remove all security access rights.

Print Setup

Print Setup displays the Print dialog box (Figure 29).

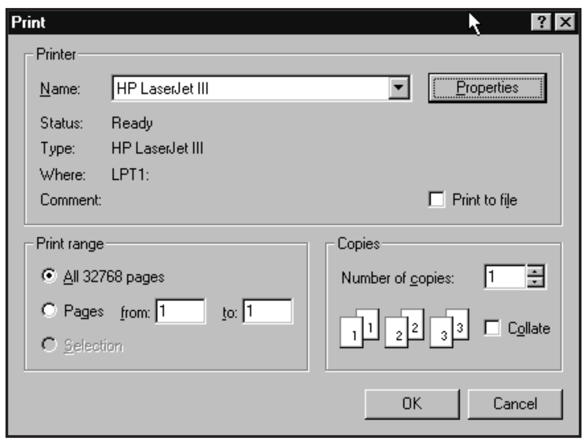


Figure 29 Print Dialog

Batch Data Displayed

If Batch data is displayed the **File** menu (Figure 30) enables you to recall another batch, close the current batch, print the data using a selected form, preview the printable results, and set up the printer.

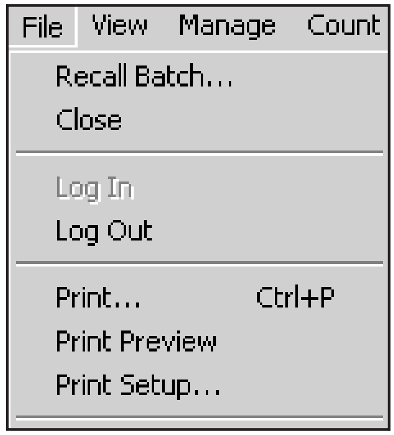


Figure 30 File Menu - Batch Data

Print and Print Preview

Both of these menu commands display the Open dialog box (Figure 31). You can select a report format from the list displayed and then click on **Open**. **Print** sends the results to the selected printer while **Print Preview** displays the results on the screen, prior to printing.

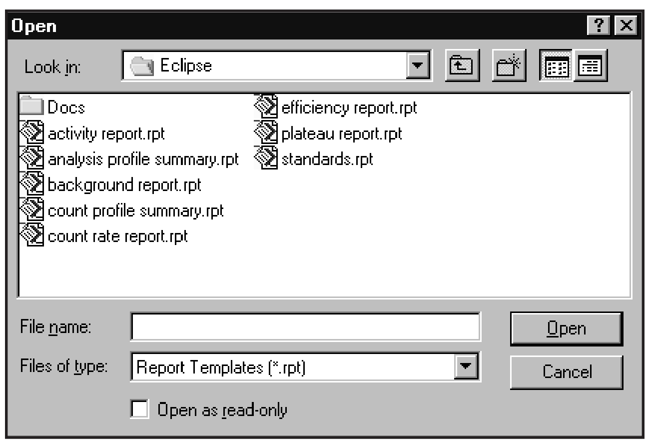


Figure 31 Selecting a Report to Print

View

The **View** menu allows you to display or hide the Toolbar and/or Status bar. If a batch is actively displayed and the cursor is clicked within the Samples data, **Update** becomes visible.

The **View** menu contains the following commands:

Toolbar

Status Bar

Manage

The **Manage** menu allows you to create a counting procedure for the calibration of the system or the analysis of unknown samples using the Procedure Manager, create auto calibration, auto QC, or super sequences using the Sequence Manager, or enter sample information for analysis using the Sample Manager.

The **Manage** menu contains the following commands:

Procedures

Samples

Sequences

See Chapter 4, *Setting Up to Count Samples*, for a detailed description of how to create a calibration or analysis procedure. See Chapter 8, *Sample Manager*, for a detailed description on how to use the Sample Manager. See Chapter 10, *Sequence Manager*, for a detailed description on how to use the Sequence Manager.

Count

From the **Count** menu, **Go Ctrl+G** command allows you to start a procedure (Figure 32) while the **Stop Ctrl+S** command allows you to stop a procedure already started.

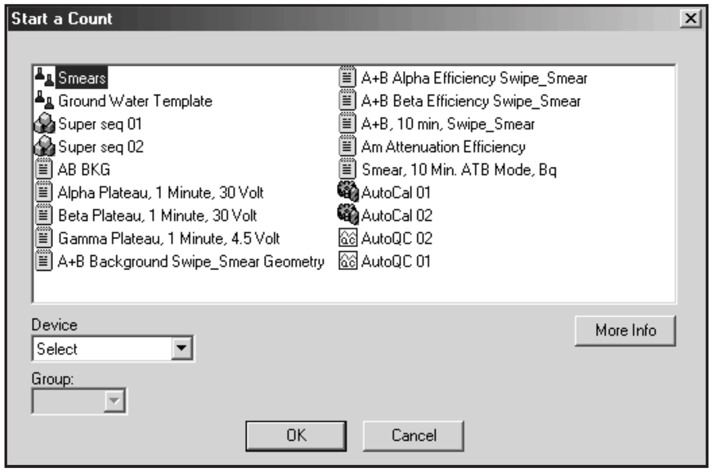


Figure 32 Count - Start a Count

All active Pre-entered Batches, Super Sequences, Procedures, AutoCal Sequences, and AutoQC Sequences will be listed within the **Start a Count** dialog box. Each type will have it’s own unique icon next to its name to indicate the type of counting procedure.

The **More Info** button will display additional information about the selected counting procedure, sequence, and/or batch.

Reports

The **Reports** menu allows you to display on the screen or send to the printer, a listing of the Calibration Standards entered into the Eclipse database. See “Entering Calibration Standards” on page 42 for a detailed description on how to enter and/or edit calibration standards.

The **Reports** menu contains the following command:

Calibration Standards

If a batch is active, **Select** command is available, allowing you to select a report form to use for printing the batch data. See “File” on page 27 for a detailed description on reports and printing data.

QC

The **QC** menu allows you to create or edit a QC profile or create a QC chart. See Chapter 9, Eclipse *QC Chart Program*, for a thorough description of the Eclipse QC Chart program.

The **QC** menu contains the following command:

Create/Edit Profiles

Create Charts

System

The **System** menu, if no batch is actively counting or displayed, will allow you to setup different items, depending on the configuration of the system(s). If Eclipse is controlling a Series 5 XLB or a Series 5 HP equipped with GasStat, then the Amplifier Setup and Gas Con. Setup functions will be available. If the Series 5 HP is equipped only with Gas Mode, then the Amplifier Setup and Gas Flow Setup items are available. For pre-Series 5 systems neither the Amplifier Setup nor Gas Con. Setup nor Gas Flow Setup functions are available. Since it is possible to operate multiple types of systems at the same time, all three of these items can be available concurrently. Hardware Status is available, regardless of the batch status, but only for Series 5 systems.

The **System** menu contains the following commands:

Alpha/Beta Amplifier Setup

Gamma Amplifier Setup

Gas Con. Setup

Gas Flow Setup

Hardware Status

Security

Alpha/Beta Amplifier Setup

The Amplifier Setup - Manual screen provides you with the ability to independently set Beta Upper Level and Alpha Lower Level discriminators for the desired spillover and deadband. For the simultaneous analysis of alpha and beta emitting isotopes, Canberra recommends adjusting these discriminators for a 3.5% beta loss and a 0.08% beta into alpha spillover using ^{210}Po and ^{90}Sr sources.

The Amplifier Setup - Manual screen (Figure 33) shows a Beta Lower Level discriminator set for a 3.5% loss and an Alpha Lower Level discriminator adjusted for a 0.08% beta into alpha spillover.

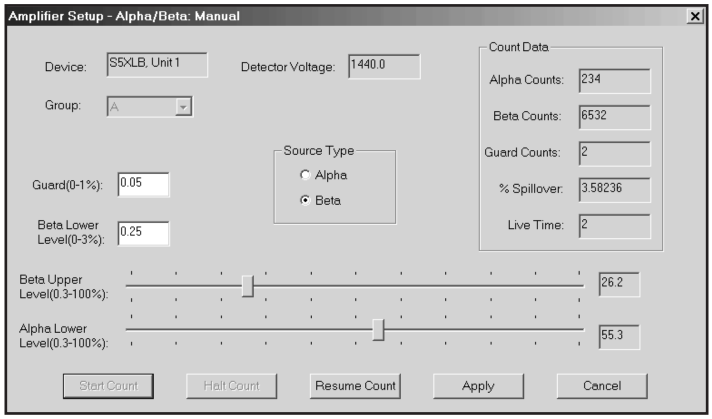


Figure 33 Amplifier Setup - Manual Screen

The Amplifier Setup - Auto screen (Figure 34) is used to define an auto ROI procedure. Once the procedure is defined and named it can be selected within the Auto Cal Sequence, refer to “Automatic Calibration (AutoCal)” on page 155 for more details.

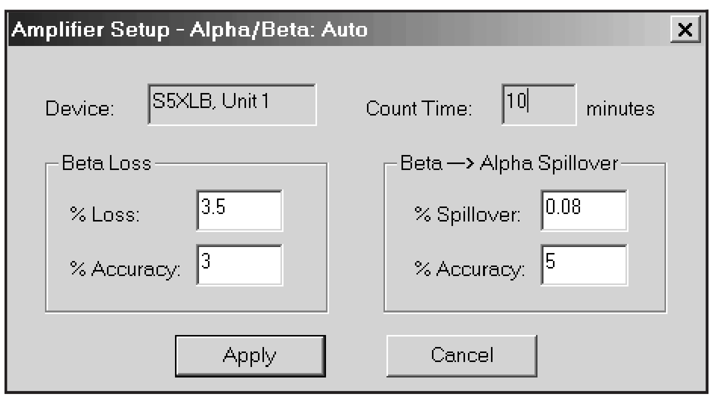


Figure 34 Amplifier Setup - Auto Screen

Note: The Amplifier Setup - Alpha/Beta: Auto screen is only used in conjunction with the AutoCal Sequence.

Gamma Amplifier Setup

The Gamma Amplifier Setup screen (Figure 35) allows you to set the energy window for Gamma events. The Gamma channel is energy calibrated for a full-scale (100%) energy of 2.0 MeV, thus the factory default Gamma channel energy window of 10% to 100% corresponds to 0.2 to 2.0 MeV.

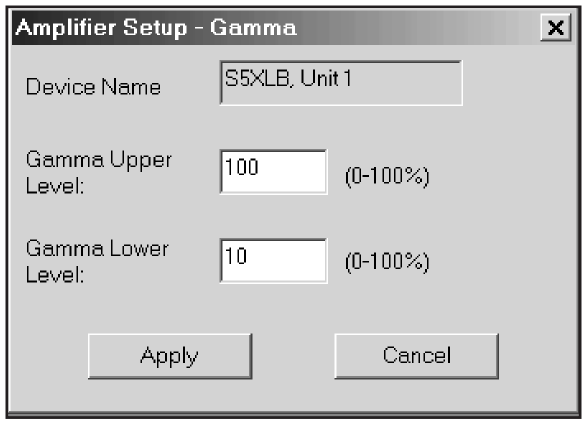


Figure 35 Gamma Amplifier Setup Screen

Gas Con Setup

From the Gas Conservation System Setup screen (Figure 36), selecting *Default* displays the default settings recommended by Canberra and can not be edited. If *Custom* is selected, you can adjust all or any of the six items by editing any of the options under Settings. Exiting this screen saves the setting. Refer to “Gas Stat Gas Conservation System” on page 193 for more details.

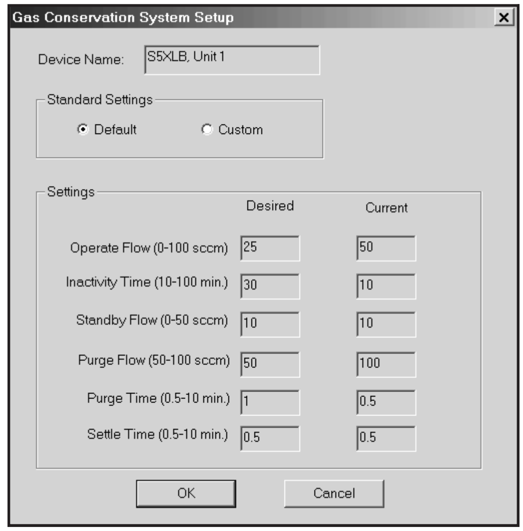


Figure 36 Gas Con Setup Screen

Gas Flow Setup

Gas Flow Setup screen (Figure 37) allows you to adjust the current flow of Series 5 systems. The adjustment is made by moving the slide left or right for the desired flow. Clicking **OK** activates this new flow choice.

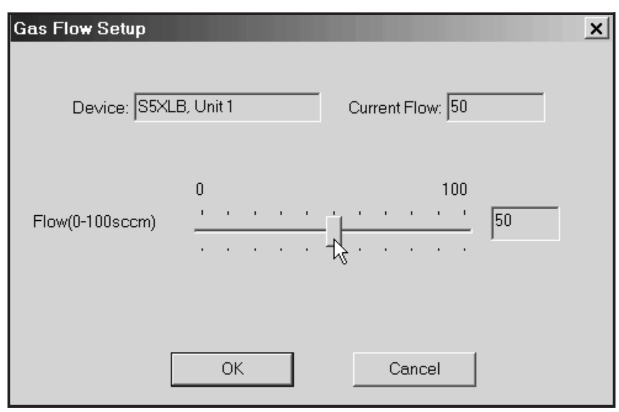


Figure 37 Gas Flow Setup Screen

Hardware Status

The Hardware Status (Diagnostics) screen (Figure 38) is available at all times for Series 4 and Series 5 systems only. Using this feature, you can at any time view the operating status of the system power supplies and the gas system. The firmware revision and date are also listed.

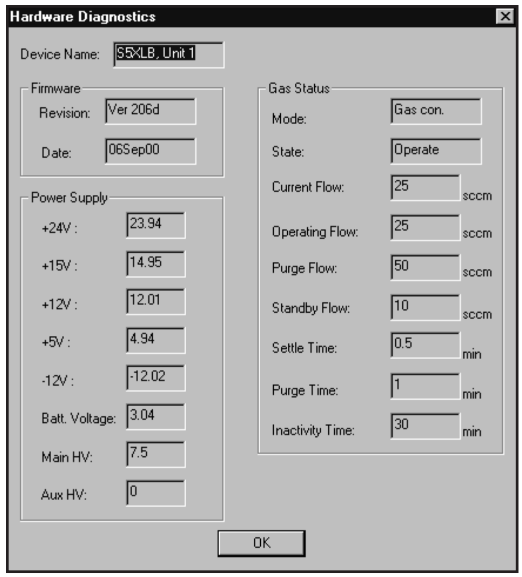


Figure 38 Hardware Status Screen

Note: The Device name will be displayed in red when an error is found and green when no error is found.

Security

The Security Setup screen allows the System Administrator to create and maintain a database of users, their group assignments and the security objects each group can access. Refer to Chapter 11, *Security Setup*, for more information.

DB Utilities

The **DB Utilities** menu allows you to Add/Edit Devices, Add/Edit Standards/Nuclides and Edit Plateaus, Edit Background Averages, Edit Efficiency Averages, Edit Spillover Averages and Edit Attenuation Averages as well as calculate the Minimum Detectable Activity or count time to meet a desired MDA. These DB Utilities features are displayed by clicking on the appropriate tab. These menu commands are described in detail in Chapter 7, *DB Utilities*.

You can also Create an Archive of batch records, View an Archive of batch records, Delete batch records, or Restore the Active Database. The first three options are available when no batch data is displayed. The last option is available only when viewing an archived database. Refer to Chapter 6, *Archiving Batch Data*, for more details.

Window

The Window menu is only available when batches are displayed.

Cascade

The Cascade submenu allows you to display multiple batches in a Cascade format.

Tile Horizontally

The Tile Horizontally submenu allows you to display multiple batches in a Tile Horizontally format.

Help

The **Help** menu displays either Help Topics for a better understanding of Eclipse LB software or About Eclipse which identifies the version of the software in use plus copyright information.

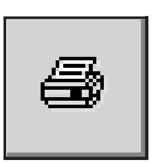
The Toolbar

The most often used features of the Menu Bar are duplicated by buttons on the Eclipse toolbar. The Toolbar is dockable in essentially any screen location and that location is saved when Eclipse is saved. If you rest your cursor on an icon for a second or two, you'll see a label describing what the icon does.

Below is a description of each button on the toolbar.

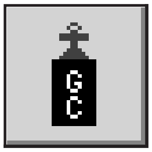
Recall batch

Clicking on the open folder button displays the Recall Batch screen. This is equivalent to selecting **File | Recall Batch**.



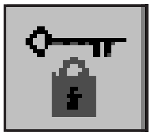
Print

Clicking anywhere within a batch data row will activate the printer button. Clicking on the printer button activates an Open report screen. Once a report is selected, printing will begin on the selected printer. This is equivalent to selecting **File | Print**.



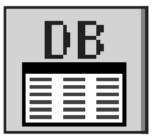
Gas Conservation System Setup

Clicking on the GC Tank button activates the Gas Conservation System Setup. This Icon is only active when no batches are active or being displayed. This is equivalent to selecting **System | Gas Con Setup**.



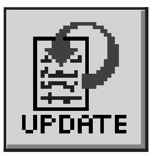
Security

Clicking on the Security button displays the Security Setup screen.



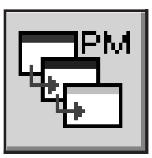
DB Utilities

Clicking on the DB button provides access to the Database Utilities. This is equivalent to selecting **DB Utilities**.



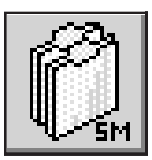
Update

The Update button is only active when a batch is counting or displayed. Depressing this button updates the analysis results to reflect Sample State and Quantity information input for each sample analyzed. This is equivalent to selecting **View | Update**.



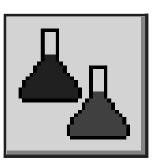
Procedure Manger

Clicking on the PM button activates the Procedure Manager. This is equivalent to selecting **Manage | Procedures**.



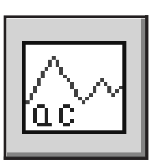
Sample Manager

Clicking on the Sample Manager button activates the Sample Manager routine. This is equivalent to selecting **Manage | Samples**.



Sequence Manager

Clicking on the SM button activates the Sequence Manager. This is equivalent to selecting **Manage | Sequence**.

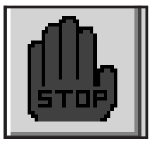


QC Chart Program

Clicking on the QC button activates the QC Chart Program.

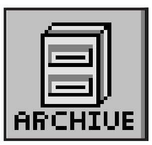
Go

Clicking on the GO button allows you to select a previously created calibration or analysis procedure, and start that procedure. This is equivalent to **Count | Go Ctrl+G**.



Stop

Clicking on the STOP button terminates the actively displayed batch. This is equivalent to **Count | Stop Ctrl+S**.



Archive

Clicking on the Archive button allows you to create an archive, view an archive, or delete batches. This Icon is only active when no batches are active or being displayed.

Restore

When viewing an archived database clicking on the Restore button will close all open batches, return to the active database, and restore all the user defined security access rights.

Required Data

Any data field requiring an entry, such as Username, is marked with an asterisk (*). You must fill in these fields before you can continue with the procedure.

4. Setting Up to Count Samples

This chapter is intended to guide the *first time* Eclipse LB software user through the manual calibration of their system. See Chapter 10, *Sequence Manager*, for details on the automatic calibration of your system. This process makes several assumptions that may or may not be applicable to your specific counting needs, which can be modified to meet those needs. The following assumptions have been made:

1. ^{210}Po (Polonium) will be used as an Alpha emitting calibration standard.
2. ^{90}Sr/^{90}Yr (Strontium/Yttrium) will be used as a Beta emitting calibration standard.
3. ^{137}Cs will be used as a Gamma emitting calibration standard.
4. Swipes will be counted in a 5/16 in. deep insert.
5. Samples will be counted in the simultaneous, Alpha + Beta, counting mode.
6. Results will be efficiency corrected to report findings in Bequerels.
7. Results will be corrected for alpha into Beta and Beta into Alpha spillover.
8. Results will be corrected for system background contributions.

Setting Up the Sample Changer

Before beginning the calibration of your Tennelec Automatic Low Background Counting System, it will prove most convenient to first set-up your sample changer. With the system sample changer empty, place an End plate under the receive (left) stack reader, a blank carrier under the send (right) stack reader and another blank carrier in the center, insertion, position.

Next, place the GROUP A carrier in the bottom position of the send (right) stack. Place the ^{210}Po standard in a 5/16 in. deep insert and then place this insert in any numbered carrier. Place this carrier on top of the GROUP A carrier.

Place the GROUP B carrier on top of the carrier containing the alpha standard. Place the ^{90}Sr source in a 5/16 in. deep insert and then place this insert in a numbered carrier. Place this carrier on top of the GROUP B carrier.

Place the GROUP C carrier on top of the carrier containing the beta standard. Place the ^{137}Cs source in a 5/16 in. deep insert and then place this insert in a numbered carrier. Place this carrier on top of the GROUP C carrier.

Place the GROUP D carrier on top of the carrier containing the gamma standard. Place a clean, uncontaminated, smear in a 5/16 in. deep insert in a carrier and then place this carrier on top of the GROUP D carrier.

Finally, place the END Carrier on top of the carrier containing the blank insert. The sample changer is now set up for calibration.

Entering Calibration Standards

Calibrated (NIST Traceable or equivalent) standards are required for the accurate calibration of your Tennelec Automatic Low Background Alpha/Beta Counting Systems. Before these calibrations can be made, the sources that will be used must be entered into the Eclipse LB database. Access to the Eclipse screen used to input the information for standards is accomplished using either of these two methods.

From the **DB Utilities** menu, choose **Add/Edit Standards/Nuclides** or from the toolbar select the **DB Utilities** button.

The Devices screen will appear. Select the **Standards and Nuclides** tab, click on **New Standard** and fill in the information for your ^{210}Po alpha standard (Figure 39).

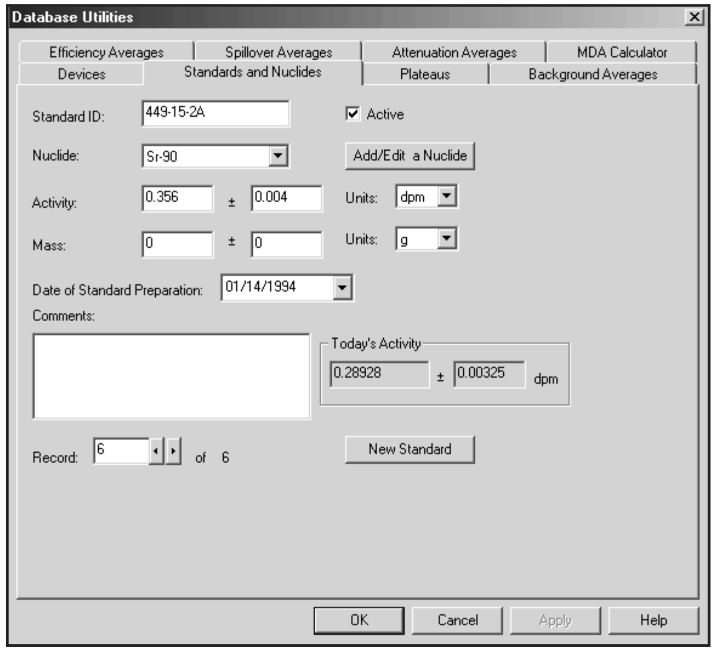


Figure 39 Entering Standards Information

1. Enter a **Standard ID** that describes your ^{210}Po source. This ID should be unique and allow you to correctly select this source, versus other ^{210}Po sources you might add later.

2. From the **Nuclide** list, select *Po-210*. You will notice that the list of nuclides available to you for calibration purposes is quite extensive.

3. Enter the activity of your standard. Units available are Bq (Bequerels), dpm (disintegrations per minute), pC (picocuries), or μCi (microcuries). If your standard lists an error for the activity, enter that in the ± space provided. The error should be in the same units as the activity.

4. Entering the **Date of Standard Preparation** is accomplished two ways. Using the convenient drop-down calendar, find the year and month and click on the day of the month and the date will be inserted in the space in a mm/dd/yyyy format. You may also enter this date manually in the mm/dd/yyyy format described.

5. The **Comments** field is provided for comments or descriptive information you might want to record for this source. This is totally optional and not required for the registration of the standard.

6. Once you have entered all of the information for your ^{210}Po source, click on **Apply** to enter it into the Eclipse LB database.

7. Current activity for the entered source is displayed as “Today’s Activity”. Today’s activity corresponds to the computer’s current date and time setting.

Follow this same procedure to enter your $^{90}Sr/^{90}Y$ beta and ^{137}Cs gamma sources into the Eclipse LB database.

Determining Operating Voltages

Eclipse LB offers three modes of operation; Alpha and Beta Simultaneous, Alpha Only, and Alpha then Beta. Each mode requires that an appropriate operating voltage or voltages, in the case of the Alpha then Beta mode, be determined. In order to determine these voltages, alpha and beta plateaus must be generated. The alpha plateau will determine the operating voltage at which the proportional counter is sensitive only to alphas and the beta plateau will determine the operating voltage at which alphas and beta are detected and separated based on pulse height. Both of these two operating voltages are required for the three modes of operation.

Creating a Plateau Procedure

Alpha, beta, and gamma plateau procedures must be created in order to generate the plateaus required to determine the correct operating voltages. Access to the Eclipse screen used to create these procedures is accomplished using either of these two methods.

From the **Manage** menu, choose **Procedures** or from the toolbar select the **Procedure Manager (PM)** button. The initial Procedure Manager screen (Figure 40) appears. A plateau calibration procedure is initiated by clicking on *Plateau procedure* and then **Next**.

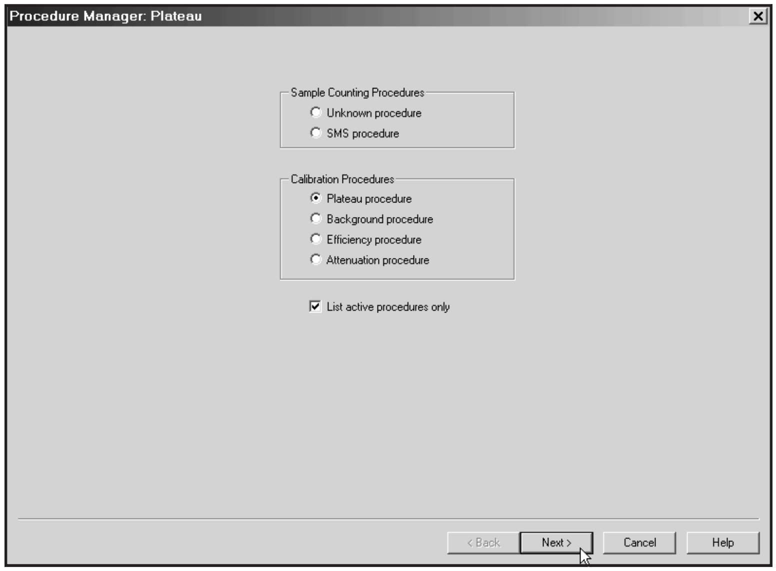


Figure 40 Selecting the Plateau Procedure

The next screen displayed will be dimmed (entries are unavailable) except the buttons for **New**, **Back**, **Finish**, **Cancel,** and **Help**. If you mistakenly selected anything other than Plateau procedure, click on **Back** and re-select Plateau procedure. If you correctly selected Plateau procedure the header of the second screen will display “Procedure Manager: Plateau”.

To create your first Plateau procedure, click on the **New** button. The **Procedure Name** dialog box will appear (Figure 41). Enter a name for your procedure, for example, “Alpha Plateau, 1 Minute, 30 Volt”. This name provides valuable information about this plateau procedure.

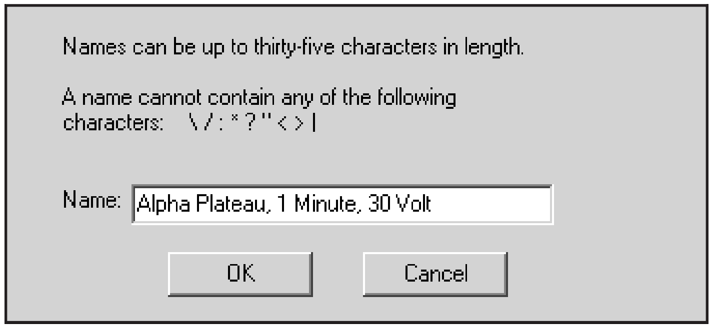


Figure 41 Entering the Procedure Name

Next, click **OK**. The default Plateau procedure displayed will be saved under the name you entered and that name will be displayed in the **Procedure** list (Figure 42). If you decide to change any of the plateau counting parameters, you must once again save this procedure after those changes have been made. Clicking on the **Save** button will save these changes.

In order to automatically print the results of this plateau measurement, click on the “>>” button to the right of the **Preselected Report** box, highlight the plateau report.rpt file and click **Open**. Once this is done, click on the **Save** button once more to save this change to the Alpha Plateau, 1 Minute, 30 Volt procedure.

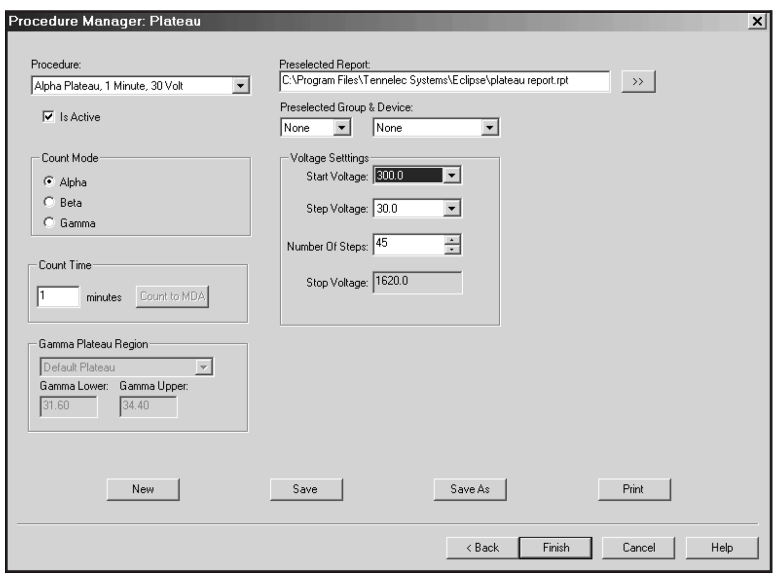


Figure 42 Entering Alpha Plateau Parameters

After alpha plateau procedure, with all changes has been saved, change the **Count Mode** from *Alpha* to *Beta*, make any other changes and then click on **Save As**. Enter the name of your choice for the beta plateau procedure, for example, “Beta Plateau, 1 Minute, 30 Volt” (Figure 43). Again, this procedure is saved automatically once the name is entered and the **OK** button is clicked.

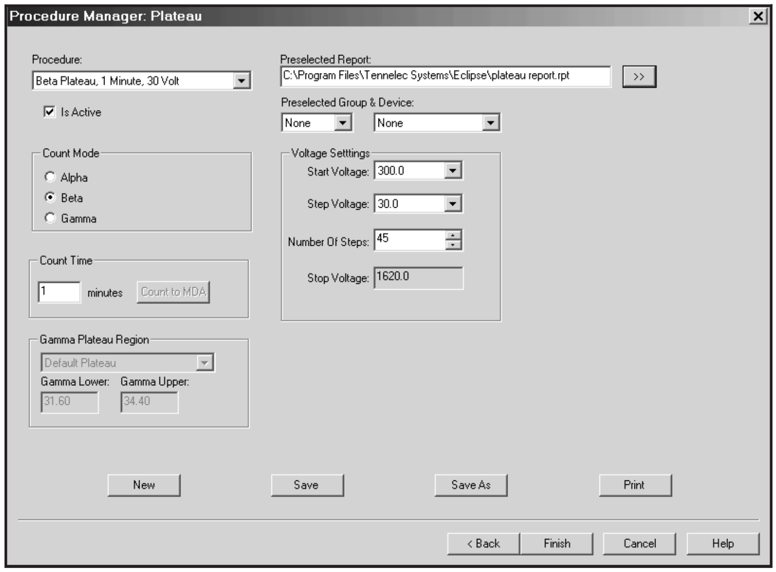


Figure 43 Entering Beta Plateau Parameters

Note: Canberra does not recommend that the voltage applied to detectors made after 1990 exceed 1650 volts. If an adjustment to the **Start Voltage**, **Step Voltage** or **Number of Steps** results in a **Stop Voltage** in excess of 1650 volts, a warning will be displayed when the procedure is saved. The maximum voltage possible is 1912.5 volts.

After beta plateau procedure, with all changes saved, change the **Count Mode** from *Beta* to *Gamma*. Set the Start Voltage to 765 volts, the Step Voltage to 4.5 volts, and the Number of Steps to 43. Make any other changes and then click on **Save As**. Enter the name, for example, “Gamma Plateau, 1 Minute, 4.5 Volt” for the gamma plateau procedure (Figure 44). Again, this procedure is saved automatically once the name is entered and the **OK** button is clicked. Once these three plateau procedures have been created and saved, click **Finish** to exit the Procedure Manager.

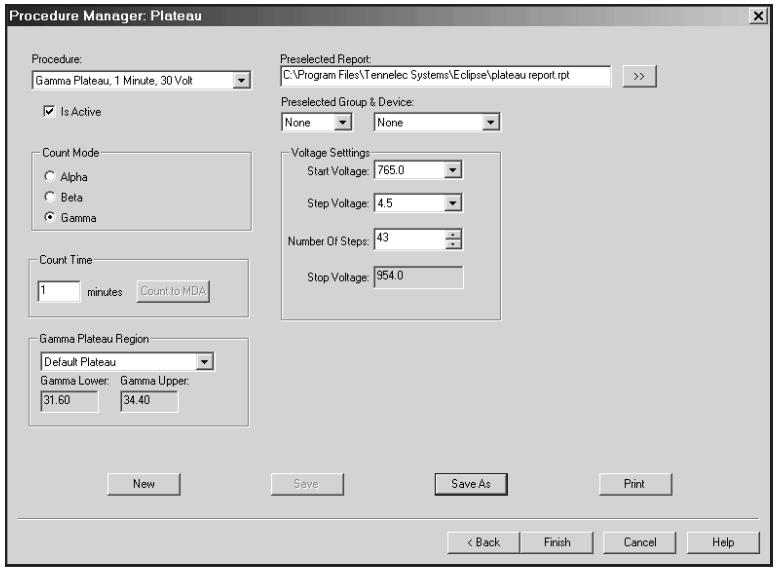


Figure 44 Entering Gamma Plateau Parameters

Generating Alpha, Beta, and Gamma Plateaus

The alpha, beta, and gamma plateaus can be initialized to run, one and then the other, without further operator intervention. Verify that the sample changer has been setup with standards and GROUP carriers as described in “Setting Up the Sample Changer” on page 41.

Starting a Count

Having done this, start the Plateau procedures you just created using any one of the following three methods:

1. Press CTRL+ G keys.
2. From the **Count** menu, choose **Go Ctrl+G**.
3. From the toolbar, select the **Go** button.

Once you have initiated the start of a procedure, the **Start a Count** dialog box appears (Figure 45). From this dialog box select the alpha Plateau procedure to be started, the **Device** you want to run this procedure on (you can operate up to four Tennelec Automatic Low Background Alpha/Beta Counting Systems with one computer) and **Group A**. Click **OK**.

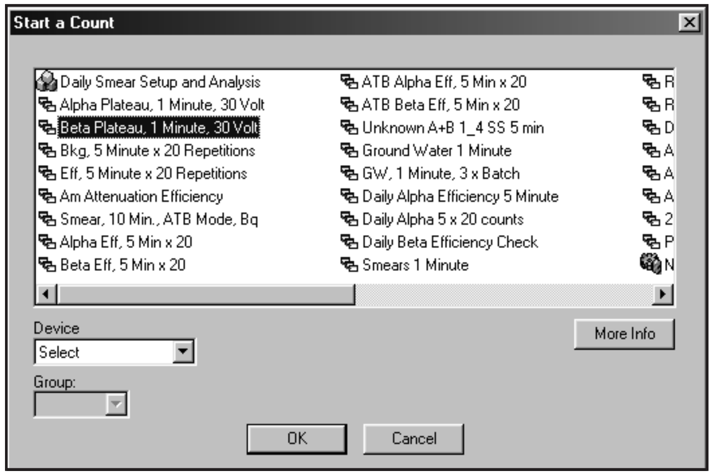


Figure 45 Starting a Plateau Procedure

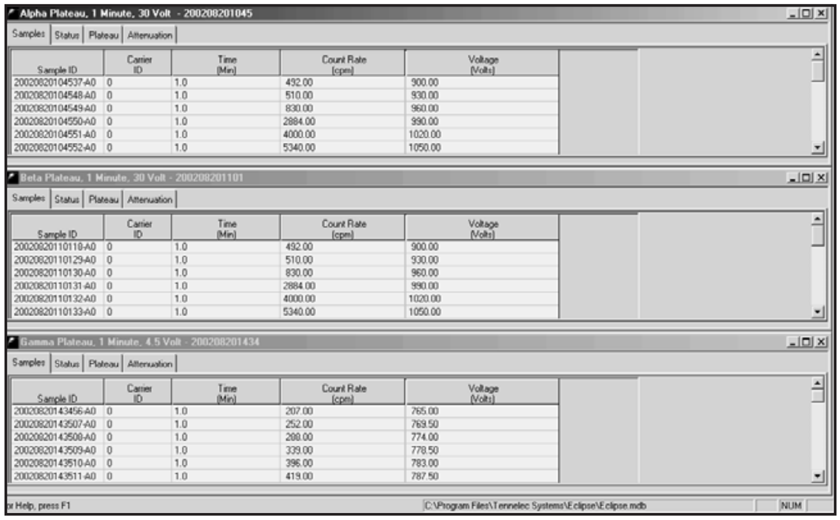
Once the alpha plateau is started, the beta and gamma plateau procedures can also be initiated. The beta and gamma plateau procedures will begin once the alpha plateau is completed. To initiate the start of the beta plateau, click on the **GO** button, select the beta plateau procedure “Beta Plateau, 1 Minute, 30 Volt”, the S5XLB, Unit 1 Device, and Group B. Click **OK**. The beta plateau will be staged right behind the alpha plateau and no further operator intervention is required. To initiate the start of the gamma plateau, click on the **Go** button, select the gamma plateau procedure “Gamma Plateau, 1 Minute, 4.5 Volt”, the S5XLB, Unit 1 Device, Group C and click **OK**. The gamma plateau will be staged right behind the beta plateau and no further operator intervention is required.

Note: If the Device/Group was predefined in the procedure definition then the selected Device/Group will be displayed as read-only.

Clicking on the **More Info** button displays the initial Procedure Manager screen.

Viewing Plateau Batches

Using the commands **Window | Tile Horizontally**, all three plateau batches can be viewed on the main Eclipse screen. Note: when plateau batches are recalled (Figure 46), the year, month, day, and time of day stamp associated with the initiation of the batch is attached to the procedure name in the header.



Alpha Plateau, 1 Minute, 30 Volt - 200208201045

Samples | Status | Plateau | Attenuation

Sample ID	Carrier ID	Time (Min)	Count Rate (cpm)	Voltage (Volts)
20020820104537-A0	0	1.0	492.00	900.00
20020820104548-A0	0	1.0	510.00	930.00
20020820104549-A0	0	1.0	830.00	960.00
20020820104550-A0	0	1.0	2884.00	990.00
20020820104551-A0	0	1.0	4000.00	1020.00
20020820104552-A0	0	1.0	5340.00	1050.00

Beta Plateau, 1 Minute, 30 Volt - 200208201101

Samples | Status | Plateau | Attenuation

Sample ID	Carrier ID	Time (Min)	Count Rate (cpm)	Voltage (Volts)
20020820110118-A0	0	1.0	492.00	900.00
20020820110129-A0	0	1.0	510.00	930.00
20020820110130-A0	0	1.0	830.00	960.00
20020820110131-A0	0	1.0	2884.00	990.00
20020820110132-A0	0	1.0	4000.00	1020.00
20020820110133-A0	0	1.0	5340.00	1050.00

Gamma Plateau, 1 Minute, 4.5 Volt - 200208201434

Samples | Status | Plateau | Attenuation

Sample ID	Carrier ID	Time (Min)	Count Rate (cpm)	Voltage (Volts)
20020820143456-A0	0	1.0	207.00	765.00
20020820143507-A0	0	1.0	252.00	769.50
20020820143500-A0	0	1.0	208.00	774.00
20020820143509-A0	0	1.0	339.00	778.50
20020820143510-A0	0	1.0	396.00	783.00
20020820143511-A0	0	1.0	419.00	787.50

or Help, press F1 | C:\Program Files\Tennelec Systems\Eclipse\Eclipse.mdb | NUM

Figure 46 Displaying the Alpha, Beta, and Gamma Plateau Results

Plateau data can be visibly displayed in graph form by clicking on the Plateau tab associated with the plateau batch to be viewed. Alpha, beta, and gamma plateau graphs are shown in Figures 47, 48, and 49.

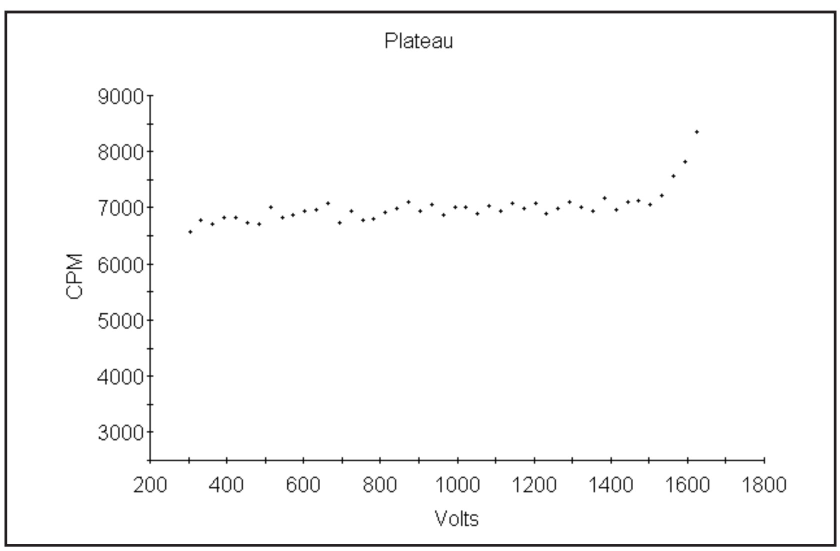


Figure 47 Alpha Plateau Graph

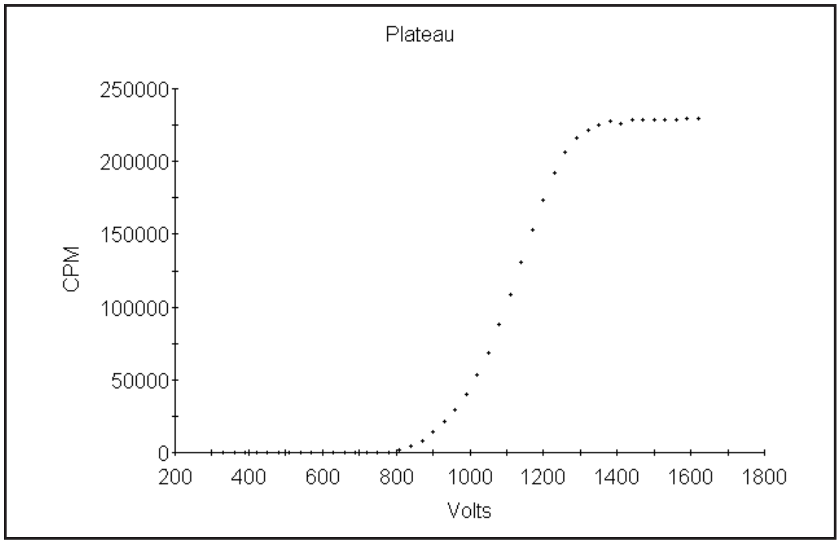


Figure 48 Beta Plateau Graph

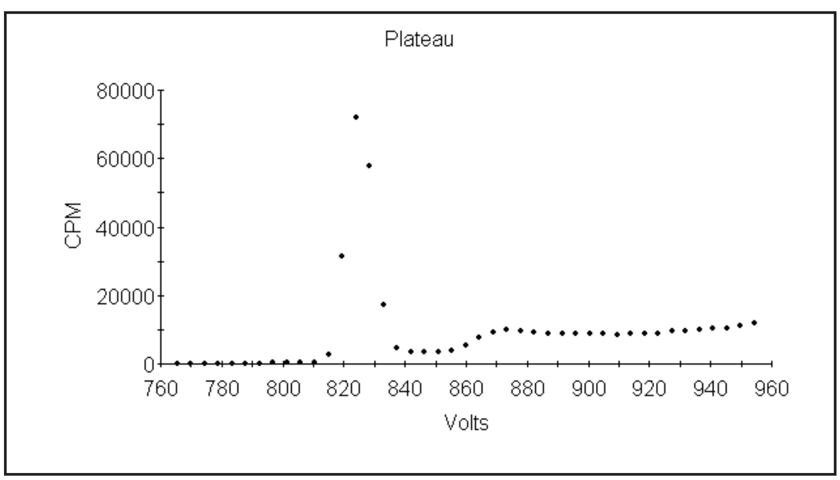


Figure 49 Gamma Plateau Graph

Scrolling down to the bottom of the Plateau tab page displays two available settings for the plateau voltage plus the current selection. Under **Available Settings**, the *Auto Selected voltage* is the operating point selected by Eclipse LB. The voltage and slope associated with this voltage are displayed to the right under the heading **Current Settings**. You can click on any data point on the plateau graph and the Voltage, CPM and Slope (%) associated with that data point is displayed as Chart Selected. If you choose to select a different voltage, not selected by Eclipse LB, this can be done by clicking on the data point associated with that voltage and then clicking on the **Use Chart Selected** button. If the voltage selected by Eclipse LB is desired, click on the **Use Auto Selected** button or simply close this screen (Figure 50).

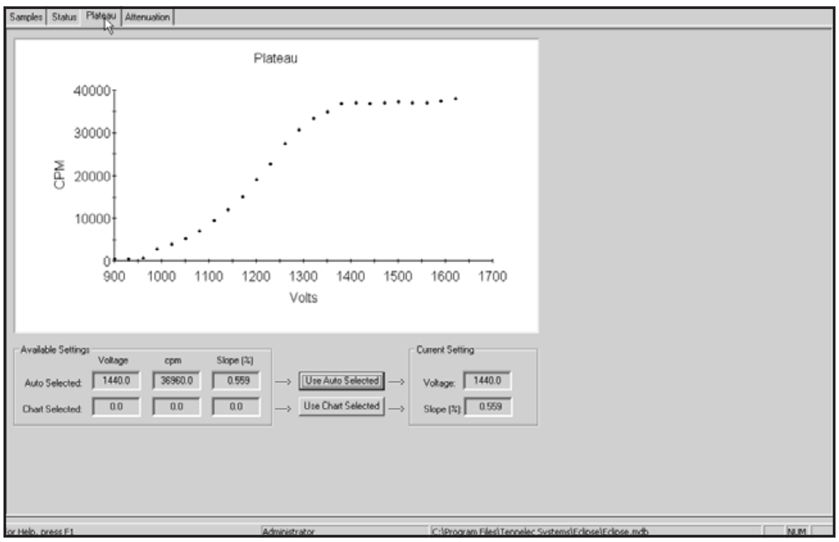


Figure 50 Changing the Operating Voltage

Using the right mouse button (right-clicking) within the plateau graph area displays the **Olectra Chart 2D Control Properties** menu of items, Axes Scales for example, that can be changed or manipulated in the plateau graph display (Figure 51).

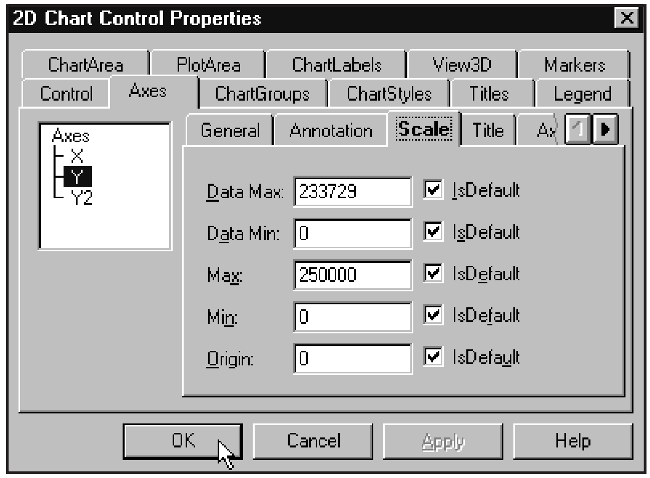


Figure 51 Chart Control Properties

Spillover Correction

When counting samples in the simultaneous, Alpha + Beta, mode of operation, it is appropriate to minimize the spillover contribution of both alpha pulses into the beta channel and beta pulses into the alpha channel. One optimum setting is to adjust the Beta Upper Level and Alpha Lower Lever discriminators so that 3.5% ± 0.2% of betas exceed the Beta Upper Level and 0.08% ± 0.02% spillover into the alpha channel. This data loss and spillover is accomplished through adjustments made using the Alpha/Beta Amplifier Setup screen.

Alpha/Beta Amplifier Discriminator Adjustment

The system alpha/beta amplifier discriminators, for Series 4 and Series 5, can only be adjusted if no batches are being counted or displayed. Once all batches are closed, all alpha/beta adjustments are made from the Alpha/Beta Amplifier Setup screen.

1. Select **System | Alpha/Beta Amplifier Setup | Manual**. If more than one device is active on the system, select the *Device* to be setup from the Select Devices dialog box (Figure 52) and click **OK**.

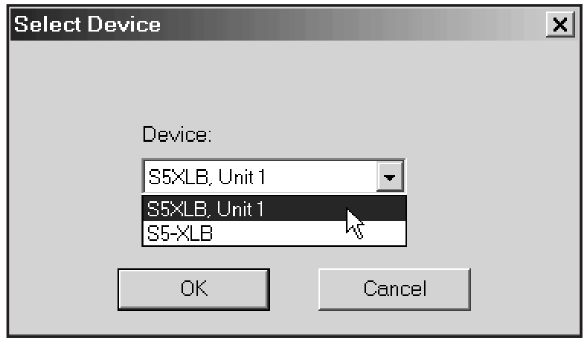


Figure 52 Select Device Dialog

2. The Amplifier Setup - Alpha/Beta Manual screen (Figure 53) appears. Select *Group B*, where the ^{90}Sr source is located and *Beta* as the Source type. Adjust the Beta Upper Level and Alpha Lower Level discriminators simultaneously until a 3.5% ± 0.2% beta spillover is achieved. It is best to have at least 20 000 beta counts for this adjustment decision. It may be necessary to **Start Count**, and then **Halt Count** and **Resume Count** several times, making adjustments at each step, to determine the correct discriminator settings.

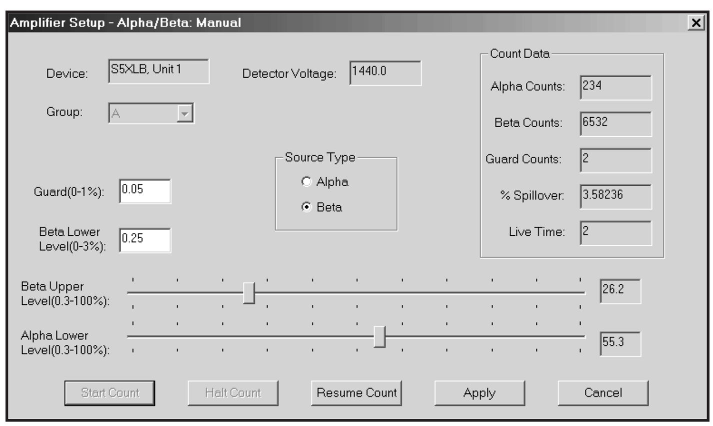


Figure 53 Alpha/Beta Amplifier Setup Screen

3. Once this 3.5% spillover value is achieved, adjust the Alpha Lower Level upward until a 0.08% ± 0.02% beta into alpha spillover is obtained. Again, it may be necessary to **Start Count**, and then **Halt Count** and **Resume Count** several times, making adjustments at each step, to determine the correct discriminator settings.

4. Once both discriminators are set at the correct values for the data loss and spillover desired, click on **Apply** and select <*new*> in the Select Region dialog box (Figure 54). Click on **OK**.

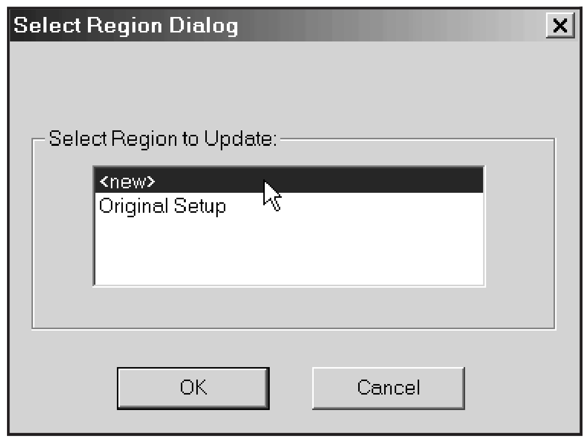


Figure 54 Select Alpha/Beta Region Dialog

5. Enter a name that defines the *Alpha/Beta Amplifier Setup* adjustments made and click on **OK** to save (Figure 55). The amplifier is now adjusted for simultaneous counting with a 3.5% beta loss and a 0.08% beta into alpha spillover.

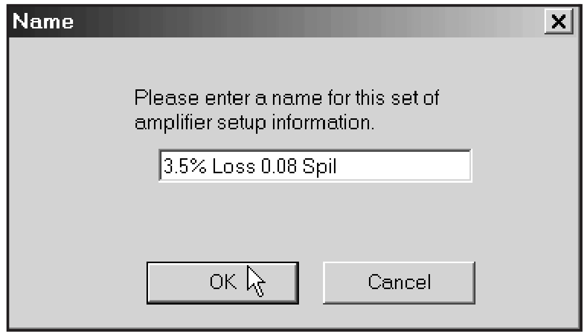


Figure 55 Entering Alpha/Beta Amplifier Setup Name

Gamma Amplifier Discriminator Adjustment

A Gamma energy window must be specified before counting samples with the Gamma counting channel enabled. The Gamma channel is energy calibrated for a full-scale (100%) energy of 2.0 MeV, thus the factory default Gamma channel energy window of 10% to 100% corresponds to 0.2 to 2.0 MeV.

The Gamma amplifier discrimination can only be adjusted if no batches are being counted or displayed. Once all batches are closed, all gamma adjustments are made from the Gamma Amplifier Setup screen.

1. Select **System | Gamma Amplifier Setup**. Select the *Device* to be setup from the Select Devices dialog box (Figure 56) and click **OK**.

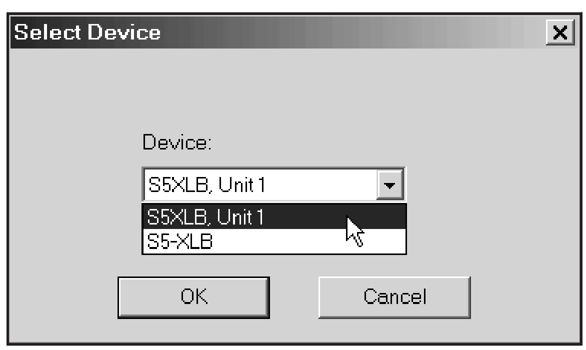


Figure 56 Select Device Dialog

2. In the Amplifier Setup - Gamma screen (Figure 57) enter the Gamma energy window values of 10% and 100%.

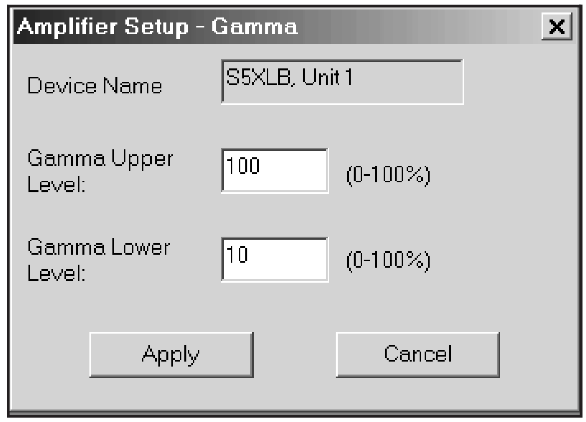


Figure 57 Gamma Amplifier Setup Screen

3. Once both discriminators are set at the correct values for the energy range, click on **Apply** and select <*new*> in the Select Region dialog box (Figure 58). Click on **OK**.

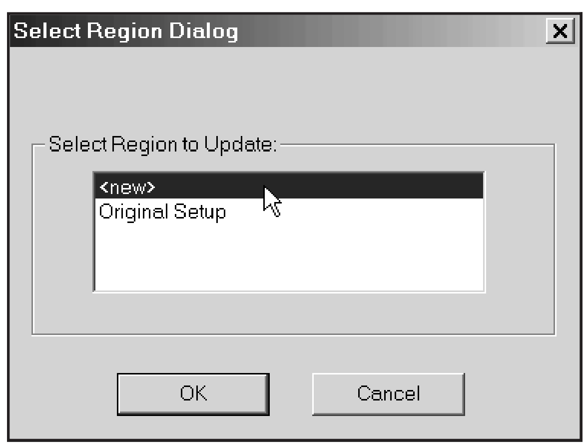


Figure 58 Select Gamma Region Dialog

4. Enter a name that defines the *Gamma Amplifier Setup* adjustments made and click on **OK** to save (Figure 59). The Gamma Amplifier is now adjusted for an energy range of 0.2 to 2.0 MeV.

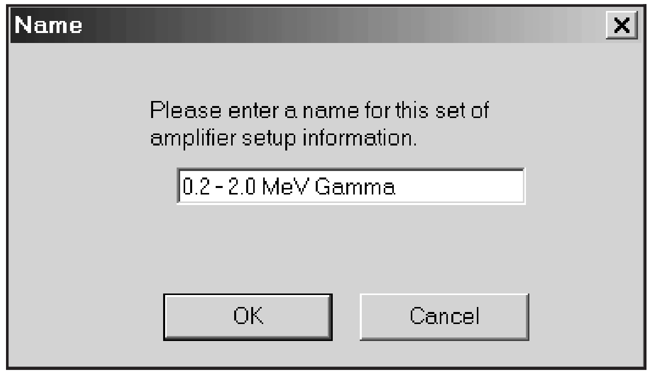


Figure 59 Entering Gamma Amplifier Setup Name

System Background

In order to correct the results of samples that have been counted for system background contributions, the contribution of that background must be measured under the exact same conditions, counting mode and geometry, as the samples that will be analyzed. Referencing the sample analysis assumptions made earlier that:

1. ^{210}Po (Polonium) will be used as an Alpha emitting calibration standard.

2. ^{90}Sr/^{90}Yr (Strontium/Yttrium) will be used as a Beta emitting calibration standard.

3. ^{137}Cs will be used as a Gamma emitting calibration standard.

4. Swipes will be counted and a 5/16 in. deep insert.

5. Samples will be counted in the simultaneous, Alpha + Beta, counting mode.

6. Results will be efficiency corrected to report findings in Bequerels.

7. Results will be corrected for Alpha into Beta and Beta into Alpha spillover.

8. Results will be corrected for system background contributions.

The system background must be determined for the simultaneous, Alpha + Beta, counting mode, using the “3.5% Loss 0.08% Spil” amplifier setup and Swipe/Smear geometry.

Creating a Background Procedure

In order to profile the system background, a procedure must be created to measure it under the conditions listed in System Background. From the **Manage** menu, choose **Procedures** or from toolbar select the **PM** button to initiate the creation of a Background Calibration procedure.

Select **New** and enter a name that describes the procedure, for example, “A+B Background Swipe_Smear Geometry”. Click **Ok**. The Background procedure appears (Figure 60) with the name entered displayed in the Procedure list.

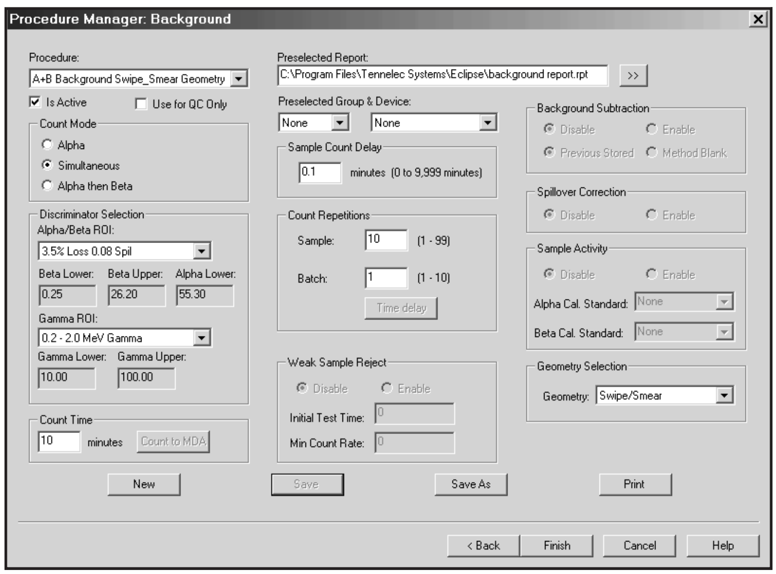


Figure 60 Entering Background Parameters

From the Background Procedure Manager the following steps are performed:

1. Select the *Simultaneous* Count Mode.
2. From the Alpha/Beta ROI Discriminator Selection, choose *3.5% Loss 0.8% Spil*.

3. From the Gamma ROI Discriminator Selection, choose *0.2-2.0 MeV Gamma*.

4. Select a Count Time of *10* minutes.

5. From the Preselected Report, choose background report.rpt.

6. Select *10* Sample Count Repetitions.

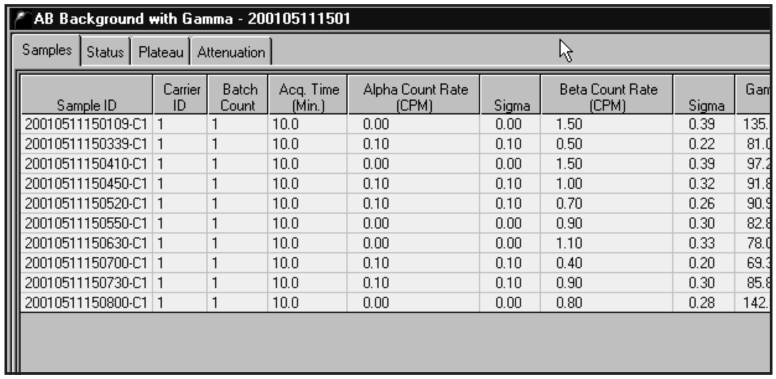
7. Select *Swipe/Smear* as the Geometry Selection.

Leave all other selection unchanged. Since some changes have been made to the initial default settings, click on the **Save** button to save these background procedure changes. Click **Finish** to exit the Procedure Manager.

Measuring the System Background

From the **Count** menu, choose **Go Ctrl+G** or from the toolbar select the **GO** button. From the **Start a Count** dialog box click on the "A+B Background Swipe_Smear Geometry" procedure. From the device list select the correct device (in this case the S5XLB, Unit 1) and from the Group list select *D*. Click on **OK**. The background procedure will begin with the system searching for the Group D carrier and then inserting the next valid sample carrier.

Once this procedure is complete, Eclipse LB will automatically print the results using the selected background report form. Clicking on the *Samples* tab (Figure 61) displays the counting results of the background measurement.



AB Background with Gamma - 200105111501

Samples | Status | Plateau | Attenuation

Sample ID	Carrier ID	Batch Count	Acq. Time (Min.)	Alpha Count Rate (CPM)	Sigma	Beta Count Rate (CPM)	Sigma	Gam
20010511150109-C1	1	1	10.0	0.00	0.00	1.50	0.39	135.
20010511150339-C1	1	1	10.0	0.10	0.10	0.50	0.22	81.0
20010511150410-C1	1	1	10.0	0.00	0.00	1.50	0.39	97.2
20010511150450-C1	1	1	10.0	0.10	0.10	1.00	0.32	91.8
20010511150520-C1	1	1	10.0	0.10	0.10	0.70	0.26	90.9
20010511150550-C1	1	1	10.0	0.00	0.00	0.90	0.30	82.8
20010511150630-C1	1	1	10.0	0.00	0.00	1.10	0.33	78.0
20010511150700-C1	1	1	10.0	0.10	0.10	0.40	0.20	69.3
20010511150730-C1	1	1	10.0	0.10	0.10	0.90	0.30	85.8
20010511150800-C1	1	1	10.0	0.00	0.00	0.80	0.28	142.

Figure 61 Background Sample Results

Clicking on the *Status* tab (Figure 62) will display a summary of this background procedure and the average background results. The bottom of this page displays the Amplifier Settings and Spillover Percentages section.

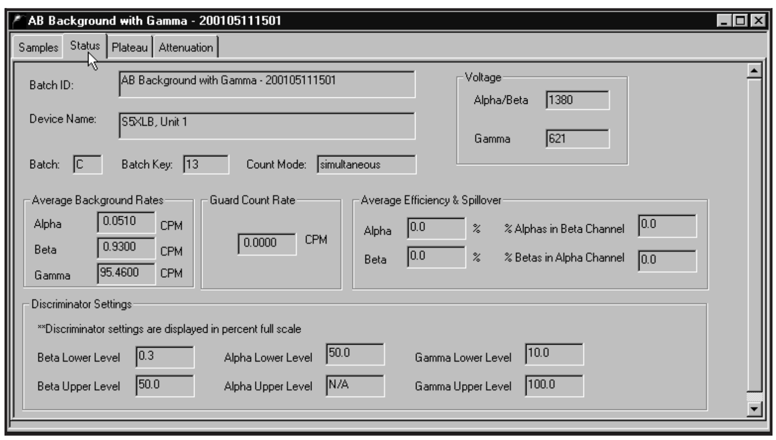


Figure 62 Summary of Background

From the **DB Utilities** menu, choose **Edit Background Averages** or click on the **DB** button and then on the *Background Averages* tab to display summaries of each background procedure. Clicking on **View Runs** will display the sample data associated with the displayed background value.

System Efficiency

In order to report the results of samples that have been counted in units of activity, alpha and beta efficiencies must be determined. These efficiencies must be determined under the exact same conditions as the samples that will be analyzed, listed here:

1. ^{210}Po (Polonium) will be used as an Alpha emitting calibration standard.

2. ^{90}Sr/^{90}Yr (Strontium/Yttrium) will be used as a Beta emitting calibration standard.

3. Swipes will be counted and a 5/16 in. deep insert.

4. Samples will be counted in the simultaneous, Alpha + Beta, counting mode.

5. Results will be efficiency corrected to report findings in Bequerels.

6. Results will be corrected for Alpha into Beta and Beta into Alpha spillover.

7. Results will be corrected for system background contributions.

Ideally, the sources used for this efficiency calibration will be produced using the same or nearly the same procedure/method as is used to prepare the unknown samples to be analyzed. In this example, the same sources as were used to generate the alpha and beta plateaus will be used for the efficiency calibration.

Creating an Efficiency Procedure

In order to determine the system alpha and beta efficiencies, procedures must be created to measure both, under the conditions listed in System Efficiency. From the **Manage** menu, choose **Procedures** or from toolbar select the **PM** button to initiate the creation of an Efficiency Calibration procedure.

Select **New** and enter a name that best describes the procedure, for example, "A+B Alpha Efficiency Swipe_Smear". Click **Ok**. The Efficiency procedure appears (Figure 63) with the name entered displayed in the Procedure list.

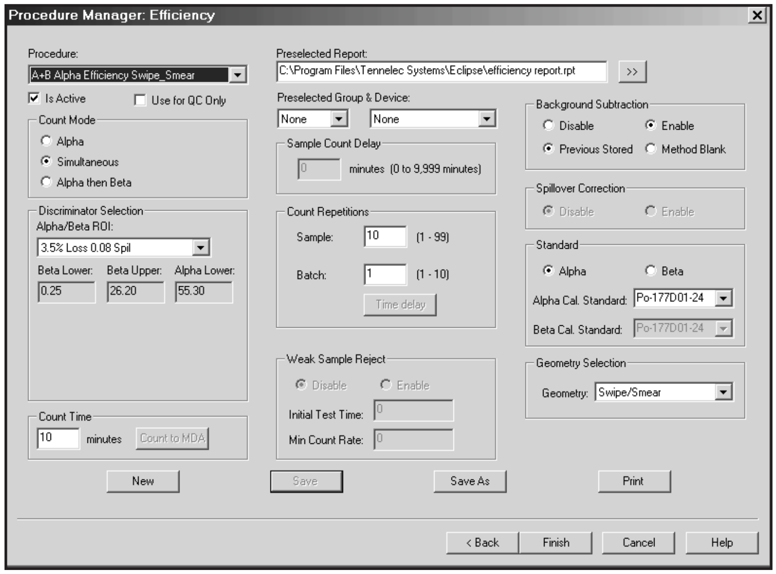


Figure 63 Entering Alpha Efficiency Parameters

From the Efficiency Procedure Manager the following steps are performed:

1. Select the *Simultaneous* Count Mode.
2. From the ROI Discriminator Selection, choose *3.5% Loss 0.08% Spil*.
3. Select a Count Time of *10* minutes.
4. From the Preselected Report, choose efficiency report.rpt.
5. Select *10* Sample Count Repetitions.
6. *Enable* Background Subtraction and use *Previous Stored*.
7. Select *Alpha* standard, *Po-177D01-20.*
8. Select *Swipe/Smear* as the Geometry Selection.

Leave all of the other selections unchanged. Since some changes have been made to the default settings, click on the **Save** button to save these alpha efficiency procedure changes.

Now that this alpha efficiency procedure is saved, change the Standard to *Beta*, select the *Beta Cal. Standard*, then click on **Save As**. Enter the name for the beta efficiency procedure, in this case “A+B Beta Efficiency Swipe_Smear” and click OK. This saves the beta efficiency procedure. Click **Finish** to exit the Procedure Manager (Figure 64).

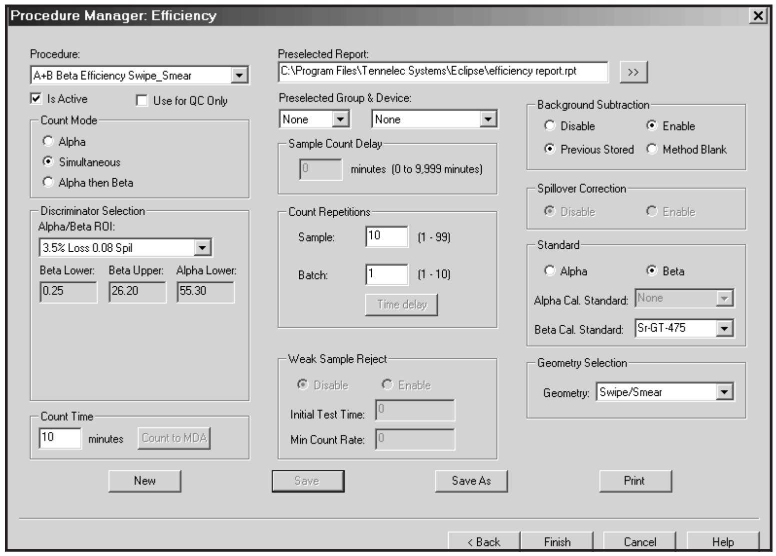
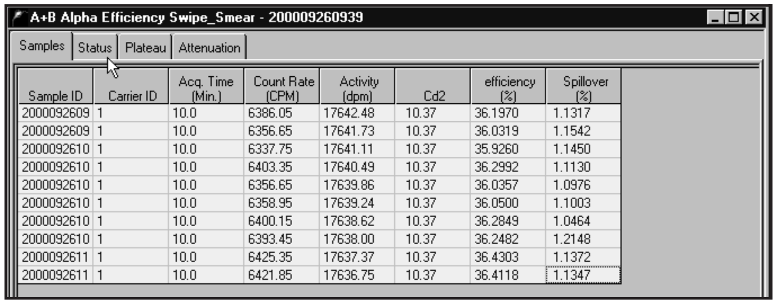


Figure 64 Entering Beta Efficiency Parameters

Measuring the System Efficiency

From the **Count** menu, choose **Go Ctrl+G** or from the toolbar select the **GO** button. From the **Start a Count** dialog box click on the “A+B Alpha Efficiency Swipe_Smear” procedure. From the Device list select the correct device (in this case the S5XLB, Unit 1) and from the Group list select *A*. Click on **OK**. The alpha efficiency procedure will begin with the system searching for the Group A carrier and then inserting the next valid sample carrier.

Once this procedure is complete, Eclipse LB will print the results using the selected efficiency report form. Clicking on the *Samples* tab (Figure 65) displays the counting results of the alpha efficiency measurement.



Sample ID	Carrier ID	Acq. Time (Min.)	Count Rate (CPM)	Activity (dpm)	Cd2	efficiency (%)	Spillover (%)
2000092609	1	10.0	6386.05	17642.48	10.37	36.1970	1.1317
2000092609	1	10.0	6356.65	17641.73	10.37	36.0319	1.1542
2000092610	1	10.0	6337.75	17641.11	10.37	35.9260	1.1450
2000092610	1	10.0	6403.35	17640.49	10.37	36.2992	1.1130
2000092610	1	10.0	6356.65	17639.86	10.37	36.0357	1.0976
2000092610	1	10.0	6358.95	17639.24	10.37	36.0500	1.1003
2000092610	1	10.0	6400.15	17638.62	10.37	36.2849	1.0464
2000092610	1	10.0	6393.45	17638.00	10.37	36.2482	1.2148
2000092611	1	10.0	6425.35	17637.37	10.37	36.4303	1.1372
2000092611	1	10.0	6421.85	17636.75	10.37	36.4118	1.1347

Figure 65 Alpha Efficiency Sample Results

Clicking on the *Status* tab will display batch information, including the Alpha Average Efficiency results of this batch procedure. The bottom of this page displays the Amplifier Settings and Spillover Percentages section (Figure 66). Repeat theses steps to initiate the beta efficiency procedure, selecting Group B. Clicking on the *Status* tab will display a view of the Beta Efficiency results (Figure 67).

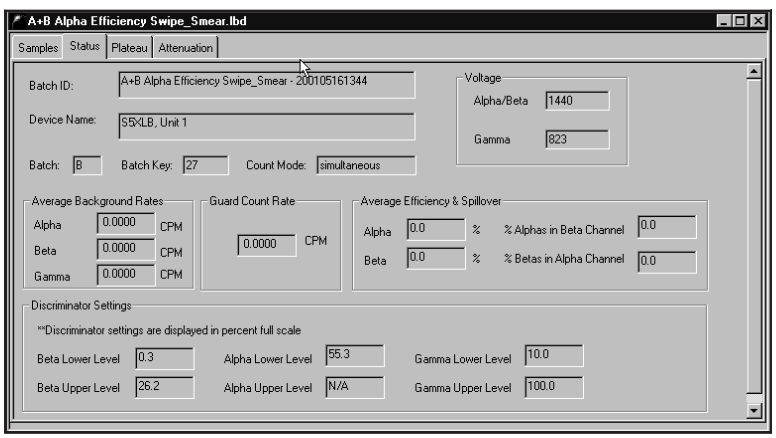


Figure 66 Summary of Alpha Efficiency

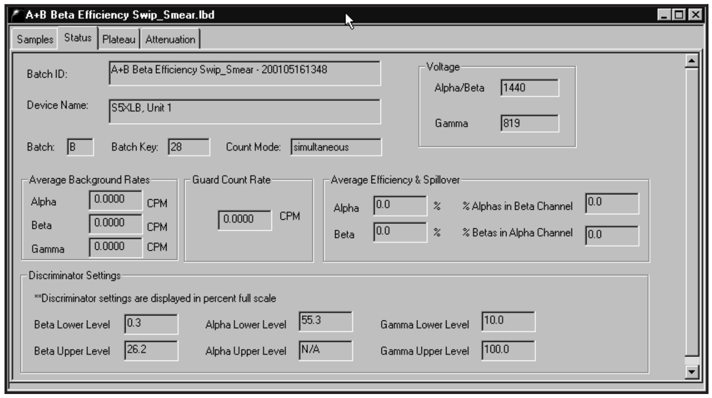


Figure 67 Summary of Beta Efficiency

From the **DB Utilities** menu, choose **Edit Efficiency Averages** or click on the **DB** button and then on the *Efficiency Averages* tab (Figure 68) to display summaries of each efficiency procedure. Clicking on **View Runs** will display the sample data associated with the displayed efficiency value (Record 3 of 4).

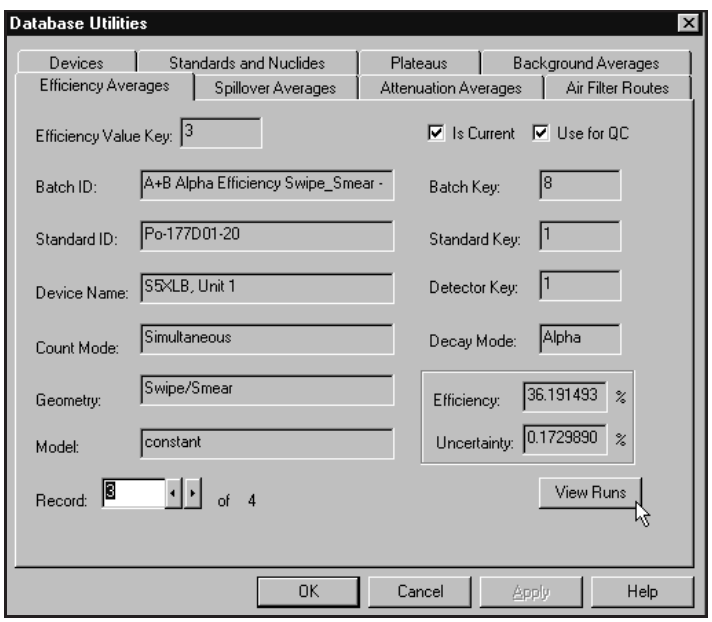


Figure 68 Efficiency Averages

Counting Samples

This system has now been completely calibrated to count samples containing alpha, beta, and gamma emitting nuclides. The samples will be placed in planchets and then in 5/16 in. deep inserts, which will then be placed in numbered carriers. They will be counted in the simultaneous, Alpha + Beta, counting mode and results will be corrected for efficiency, background, and spillover. The results will be reported in Bequerels.

Creating an Unknown Sample Counting Procedure

From the **Manage** menu, choose **Procedures** or from the toolbar select the **PM** button to initiate the creation of Sample Counting Procedure. From the initial Procedure Manager screen (Figure 69) click on *Unknown procedure* and then **Next**.

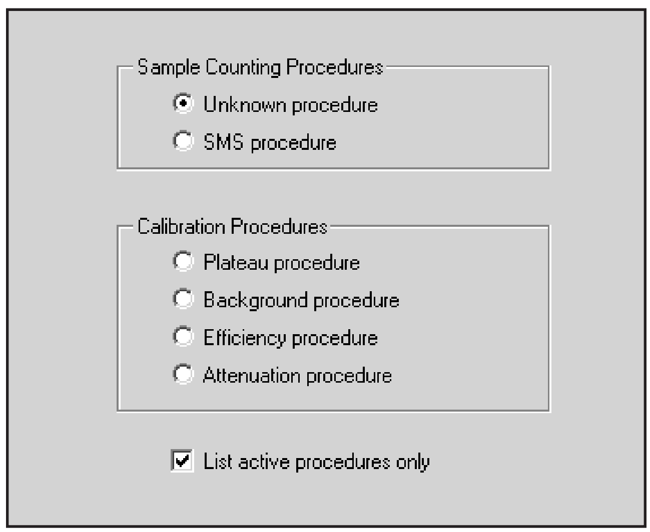


Figure 69 Selecting the Unknown Procedure

Select **New** and enter a name that best describes the procedure, for example, “A+B, 10 min, Swipe_Smear”. Click **Ok**. The Unknown procedure appears (Figure 70) with the name entered displayed in the Procedure list.

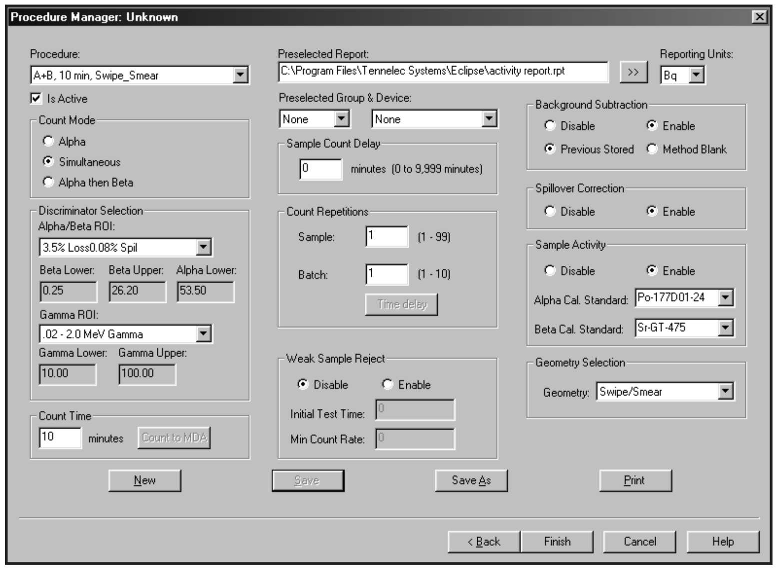


Figure 70 Entering Sample Counting Parameters

From the Procedure Manager the following steps are performed:

1. Select the *Simultaneous* Count Mode.

2. From the Alpha/Beta ROI Discriminator Selection, choose *3.5% Loss 0.08% Spil*.

3. From the Gamma ROI Discriminator Selection, choose *0.2-2.0 MeV Gamma*.

4. Select a Count Time of *10* minutes.

5. From the Preselected Report, choose activity report.rpt.

6. Select the desired reporting units: Bq, pCi, µCi, or dpm.

7. Select *1 Sample* Count Repetitions.

8. *Disable* Weak Sample Reject.

9. *Enable* Background Subtraction and use *Previous Stored*.

10. *Enable* Spillover Correction.

11. *Enable* Sample Activity and select the *Alpha* and *Beta* Calibration Standards

12. Select *Swipe/Smear* as the Geometry Selection.

Once this has been done, click on the **Save** button to save these changes. Click **Finish** to exit the Procedure Manager.

Counting Unknown Samples

To count unknown samples:

1. Place about 10 sample swipes into planchets (if actual samples are not available, use blank swipes) and place these planchets into carriers fitted with 5/16 in. deep Stainless Steel inserts.

2. Remove the alpha and beta standard carriers, GROUP carriers and the blank background carrier from the system send stack.

3. Place the GROUP A carrier in the bottom position of the send stack and the carriers containing samples on top of it.

4. Place an END carrier on top of the last sample.

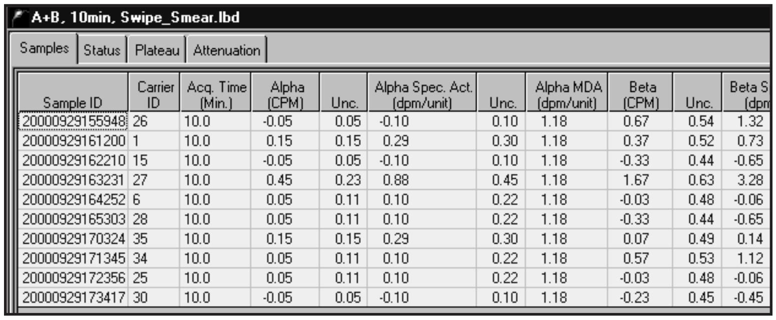
5. From the **Count** menu, choose **Go Ctrl+G** or from the toolbar select the **GO** button.

6. From the **Start a Count** dialog box click on the “A+B, 10 min, Swipe_Smear” procedure.

7. From the device list select the correct device (in this case the S5XLB, Unit 1) and from the Group list select *A*.

8. Click on **OK**.

Clicking on the *Samples* tab (Figure 71) will display the sample counting results.



A+B, 10min, Swipe_Smear.lbd

Samples | Status | Plateau | Attenuation

Sample ID	Carrier ID	Acq. Time (Min.)	Alpha (CPM)	Unc.	Alpha Spec. Act. (dpm/unit)	Unc.	Alpha MDA (dpm/unit)	Beta (CPM)	Unc.	Beta S (dpm
20000929155948	26	10.0	-0.05	0.05	-0.10	0.10	1.18	0.67	0.54	1.32
20000929161200	1	10.0	0.15	0.15	0.29	0.30	1.18	0.37	0.52	0.73
20000929162210	15	10.0	-0.05	0.05	-0.10	0.10	1.18	-0.33	0.44	-0.65
20000929163231	27	10.0	0.45	0.23	0.88	0.45	1.18	1.67	0.63	3.28
20000929164252	6	10.0	0.05	0.11	0.10	0.22	1.18	-0.03	0.48	-0.06
20000929165303	28	10.0	0.05	0.11	0.10	0.22	1.18	-0.33	0.44	-0.65
20000929170324	35	10.0	0.15	0.15	0.29	0.30	1.18	0.07	0.49	0.14
20000929171345	34	10.0	0.05	0.11	0.10	0.22	1.18	0.57	0.53	1.12
20000929172356	25	10.0	0.05	0.11	0.10	0.22	1.18	-0.03	0.48	-0.06
20000929173417	30	10.0	-0.05	0.05	-0.10	0.10	1.18	-0.23	0.45	-0.45

Figure 71 Smear Sample Results

5. Creating System Counting Procedures

A Procedure is a set of instructions that describe the conditions under which a sample will be counted plus additional instructions on how the results of that count will be analyzed and reported. Eclipse LB provides you with the ability to create calibration and analysis procedures for a Tennelec Automatic Low Background Alpha/Beta Counting Systems using unique, single page templates.

System Options

The text boxes displayed in each procedure will depend on how the Eclipse software detects the system configuration.

Gamma Detector Option

If the Eclipse software detects there are no counting systems connected with the gamma detector installed, no gamma options are displayed.

If the Eclipse software detects at least one system with the gamma detector installed, the gamma options will appear as active on each procedure screen. For those system with no gamma detector installed, the Eclipse software will displayed each gamma option as grayed out.

SMS Option

The SMS procedure selection will only be visible if the Sample Management Software has been installed.

Procedure Manager

The Eclipse LB Procedure Manager can be initiated using either of two methods. From the **Manage** menu, choose **Procedures** or from the toolbar select the **Procedure Manager (PM)** button. The initial Procedure Manager screen (Figure 72) appears allowing you to select and create, or edit, a Sample Counting or Calibration Procedure.

Refer to page 72 for more information on Calibration Procedures and page 89 for more information on Sample Counting Procedures.

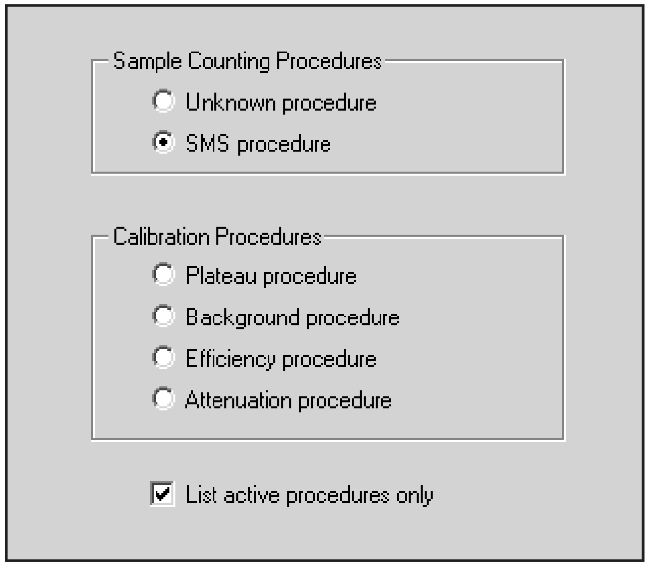


Figure 72 Initial Procedure Manager Screen

Select the procedure type then click on **Next** or **Cancel** to exit the initial Procedure Manager screen.

Select the “List active sequences only” check box to view all or only the active sequences. The default is to list all active sequences.

Calibration Procedures

Four Calibration Procedure templates: Plateau, Background, Efficiency and Attenuation, are provided for the calibration of a Tennelec Automatic Low Background Alpha/Beta Counting Systems.

Plateau Procedure

System alpha, beta, and gamma plateaus must be generated and the appropriate operating voltages calculated, before any other procedure can be run. A plateau calibration procedure is created by starting the Procedure Manager, clicking on *Plateau procedure* then **Next**. The Procedure Manager: Plateau screen is displayed. If no plateau procedures have been previously created, click **New** and enter an appropriate procedure name (Figure 73).

The *Procedure Name* can be up to 35 characters long. The symbols, \ / : * ? “ < > and | can not be used. The procedure name should be sufficiently descriptive that you will clearly understand the data acquisition and analysis details of this procedure, when choosing it for execution.

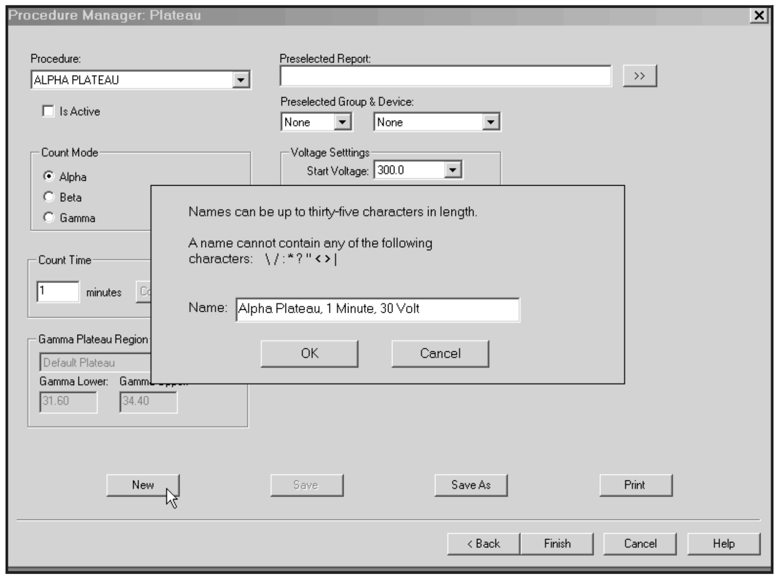


Figure 73 Plateau Screen with Procedure Name Dialog

After clicking **OK**, the procedure name will then appear in the *Procedure* list. Eclipse LB will automatically save this procedure as “active” with default values (Figure 74). If these values remain unchanged, click **Finish** to exit the Procedure Manager or **Back** to return to the initial Procedure Manager screen.

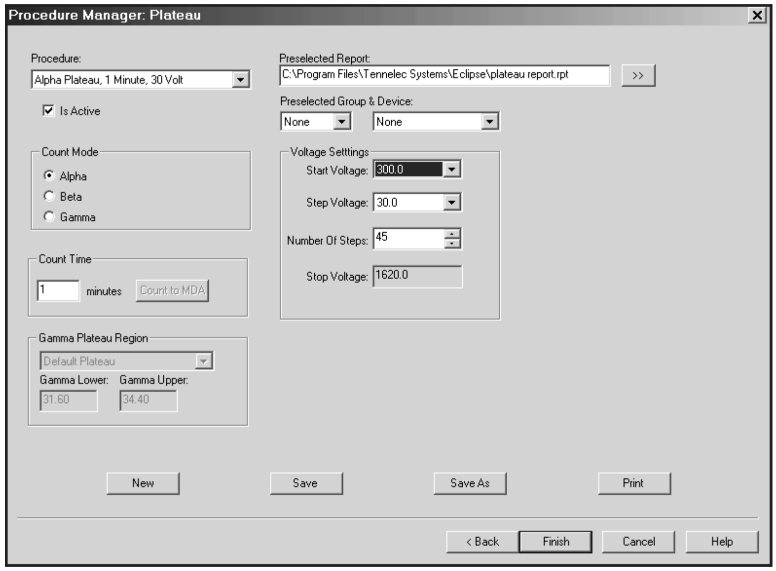


Figure 74 Plateau Screen

The following options are available for the creation of a plateau procedure. If any of these options/values are changed, the procedure must be saved once again.

Note: Options with an asterisk are available when the Eclipse software detects an counting system with the gamma detector option installed.

Is Active

Selecting the Is Active check box will change an active status to inactive and an inactive status to active. The default for plateau procedures is *Active*. Inactive procedures are not available for use.

Count Mode

Alpha, Beta, or *Gamma; default is *Alpha*.

This identifies the plateau to be generated plus the identity of calculated voltage point. The Alpha plateau voltage is used for Alpha Only counting procedures and as the starting voltage for Alpha then Beta counting procedures. The Beta plateau voltage is used for the second count of Alpha then Beta procedures and for simultaneous Alpha plus Beta counting. The Gamma plateau voltage is used for operation of the Gamma channel detector.

Count Time

Selectable from 0.2 to 9999.0 minutes, live time; default is *1 minute*.

This is the counting time per voltage step for the generation of the plateau data. Eclipse LB plots and uses counts per minute for the operating voltage calculation.

*Gamma Plateau Region

The Gamma Plateau Region specifies the energy window to be used in determining the operating voltage for the Gamma detector. The default plateau values of 31.6 and 34.4 provides a narrow window centered at 33.1%. Used in conjunction with the 662 KeV energy line of the ^{137}Cs calibration source, this sets the full scale (100%) Gamma equivalent to 2.0 MeV.

Preselected Report

The default for this procedure option is that no report is selected.

Eclipse LB will automatically print the results of the plateau procedure if plateau report.rpt is selected by clicking on the “>>” button. If no report is selected, a plateau report can be manually printed after the plateau is completed.

Preselected Group & Device

Preselected Group

A through J; default is *None*.

If a Group letter, A through J, is selected from the drop-down list, this plateau procedure will always search the Tennelec Low Background Counting System for that Group carrier as the location of the plateau source. If no Group is selected, you must make this selection at the time the procedure is initiated.

Preselected Device

Any registered counting system; default is *None*.

If a registered system, Device, is selected, this procedure will only run on that system. If no system is selected, you must make this selection at the time the procedure is initiated. This is most appropriate for computer systems with Eclipse LB operating more than one counting system.

Voltage Settings - Alpha or Beta Count Modes

Determines the plateau voltage range for this analysis plus the resolution of the voltage steps.

Start voltage

Selectable from 300.0 volts to 900.0 volts, in 7.5-volt steps.

Step Voltage

Select from 7.5 volts, 15.0 volts, 22.5 volts or 30.0 volts. Default is 30.0 volts. Allows you to set the step voltage for the plateau generation.

Number of Steps

Selectable from 1 to 216 steps. Default is 45 steps.

Stop Voltage

The sum of the Start Voltage plus the Step Voltage times the number of Steps.

Note: Canberra does not recommend that the voltage applied to detectors made after 1990 exceed 1650 volts. If an adjustment to the Start Voltage, Step Voltage or Number of Steps results in a Stop Voltage in excess of 1650 volts, a warning will be displayed when the procedure is saved.

*Voltage Settings - Gamma Count Mode:

Determines the plateau voltage range for this analysis plus the resolution of the voltage steps.

Start voltage

Selectable from 450.0 volts to 999.0 volts, in 4.5-volt steps.

Step Voltage

Select from 4.5 volts, 9.0 volts, 13.5 volts or 18.0 volts. Default is 4.5 volts. Allows you to set the step voltage for the plateau generation.

Number of Steps

Selectable from 1 to 156 steps. Default is 43 steps.

Stop Voltage

The sum of the Start Voltage plus the Step Voltage times the number of Steps. The maximum Stop Voltage is 1147.5 volts.

Once all of the selections have been made, click **Save** to save this procedure or save it under another name using the **Save As** button. This process may be repeated to prepare all of the plateau calibration procedures needed. Once this is done, click **Finish** to exit Procedure Manager or **Back** to return to the initial Procedure Manager screen.

Background Procedure

If unknown sample analysis results are to be corrected for system background, the Tennelec Low Background Counting System must be calibrated to determine the alpha, beta, and gamma backgrounds.

A background calibration procedure is created by starting the Procedure Manager, clicking on *Background procedure* then **Next**. The Procedure Manager: Background screen is displayed. If no background procedures have been previously created, click **New** and enter an appropriate procedure name (Figure 75).

The *Procedure Name* can be up to 35 characters long. The symbols, \ / : * ? “ < > and | can not be used. The procedure name should be sufficiently descriptive that you will clearly understand the data acquisition and analysis details of this procedure, when choosing it for execution.

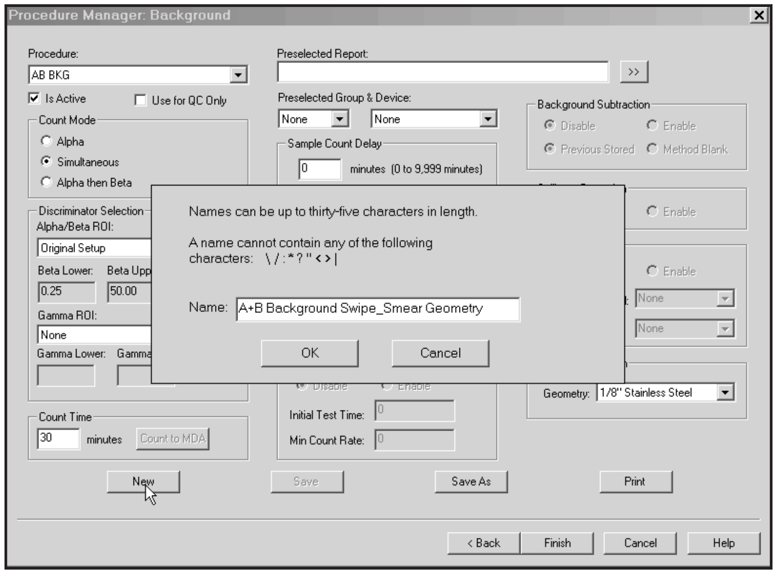


Figure 75 Background Screen with Procedure Name Dialog

After clicking **OK**, the procedure name will then appear in the *Procedure* list. Eclipse LB will automatically save this procedure as “active” with default values (Figure 76). If these values remain unchanged, click **Finish** to exit the Procedure Manager or **Back** to return to the initial Procedure Manager screen.

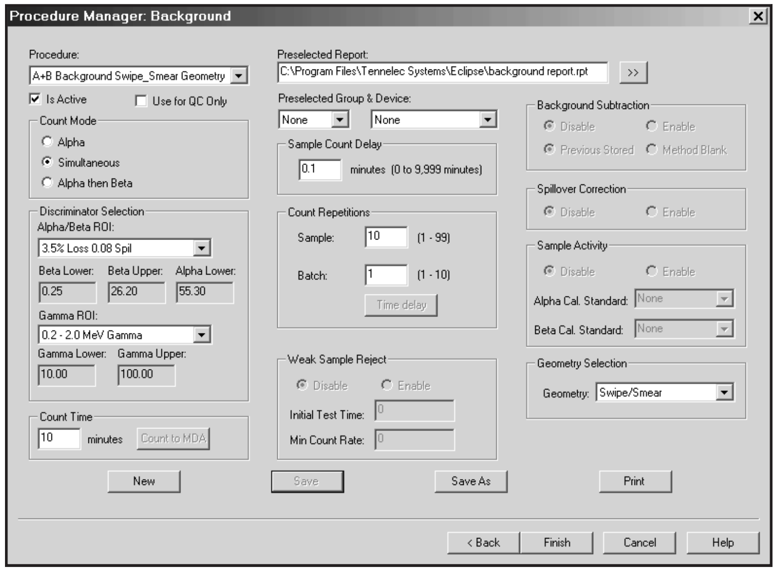


Figure 76 Background Screen

The following options are available for the creation of a background calibration procedure. If any of these options/values are changed, the procedure must be saved once again.

Note: Options with an asterisk are available when the Eclipse software detects an counting system with the gamma detector option installed.

Is Active

Selecting the Is Active check box will change will change an active status to inactive and an inactive status to active. The default for background procedures is *Active*. Inactive procedures are not available for use.

Use for QC Only

The default setting is with the check box cleared. Selecting this option allows the procedure to be used with an Auto QC sequence to verify system performance. Use of this procedure in a QC sequence does not change the system calibration.

Count Mode

Three count modes are available for the analysis of unknown samples. If all three modes will be utilized in the analysis of unknown samples, the system must be calibrated for each mode. This will require that three background calibration procedures be written and executed.

Alpha

The Alpha (alpha only) Count Mode sets the system high voltage to the alpha plateau voltage. At this voltage, the proportional counter is only sensitive to alpha radiation.

Simultaneous

The simultaneous count mode sets the system high voltage to the beta plateau voltage. At this voltage, the proportional counter is sensitive to all ionizing radiation and the separation of alpha and beta particles is accomplished using pulse height.

Alpha then Beta

In the alpha then beta mode of operation the sample is counted twice; first at the alpha only voltage and then at the simultaneous voltage. The simultaneous voltage counts are then corrected for the alpha only voltage counts.

ROI Discriminator Selection

Alpha/Beta ROI

Active only for the Simultaneous Count Mode, this selection uses previously determined amplifier settings for the separation of alpha and beta particles. See “Alpha/Beta Amplifier Discriminator Adjustment” on page 53 for a description of the amplifier setup discriminator settings. Default settings for Alpha Only and Alpha then Beta modes can not be changed.

*Gamma ROI

This selection specifies the energy window of the gamma counting channel. The gamma counting channel operation is independent of the Alpha/Beta channel. See “Gamma Amplifier Discriminator Adjustment” on page 56 for more details.

Count Time

0.2 to 9999.0 minutes, live time; default is *1 minute*.

Preselected Report

The default for this procedure option is that no report is selected.

Eclipse LB will automatically print the results of the background procedure if background report.rpt is selected. Make this selection by clicking on the “>>” button. If no report is selected, a background report can be manually printed after the analysis is completed.

Pre-selected Group & Device

Preselected Group

A through J; default is *None*.

If a Group letter, A through J, is selected from the drop-down list, this background procedure will always search the Tennelec Low Background Counting System for that Group carrier as the location of the background blank. If no Group is selected, you must make this selection at the time the procedure is initiated.

Preselected Device

Any registered counting system; default is *None*.

If a registered system, Device, is selected, this procedure will only run on that system. If no system is selected, you must make this selection at the time the procedure is initiated. This is most appropriate for computer systems with Eclipse LB operating more than one counting system.

Sample Count Delay

Any registered counting system; default is *None*. Selectable from 0 to 9999 minutes.

The delay time between counting intervals. If a value other than “0” is entered, the system will count the sample for the selected Count Time, wait for the amount of time selected for the Sample Count Delay and then count the sample again, for the number of Count Repetitions selected.

Count Repetitions

Sample

Selectable from 1 to 99; default is “1”.

This is the number of times a sample will be counted for the selected Count Time before the next sample is inserted for analysis.

Batch

Selectable from 1 to 10; default is “1”.

This is the number of times a Batch (Group) of samples will be counted before the system proceeds to another Group or Batch of samples. Note: This option requires firmware version 2.06 or higher.

Geometry Selection

Just as for Count Mode, if multiple geometries will be used in the analysis of unknown samples, the system must be background calibrated for each of those geometries. From the *Geometry* list choose: 1/8” Stainless Steel, ¼” Stainless Steel, 5/16” Stainless Steel, Daily, or Swipe/Smear. Separate procedures must be created for background calibrations for each geometry selection required.

Once all selections and changes have been made, click **Save** to save this procedure or save it under another name using the **Save As** button. This process can be repeated to prepare all of the background calibration procedures needed. Once this is done, click **Finish** to exit the Procedure Manager or **Back** to return to the initial Procedure Manager screen.

Efficiency Procedure

An efficiency calibration procedure is created by starting the Procedure Manager and clicking on *Efficiency procedure* then **Next**. The Procedure Manager: Efficiency screen is displayed. If no efficiency procedures have been previously created, click **New** and enter an appropriate procedure name (Figure 77).

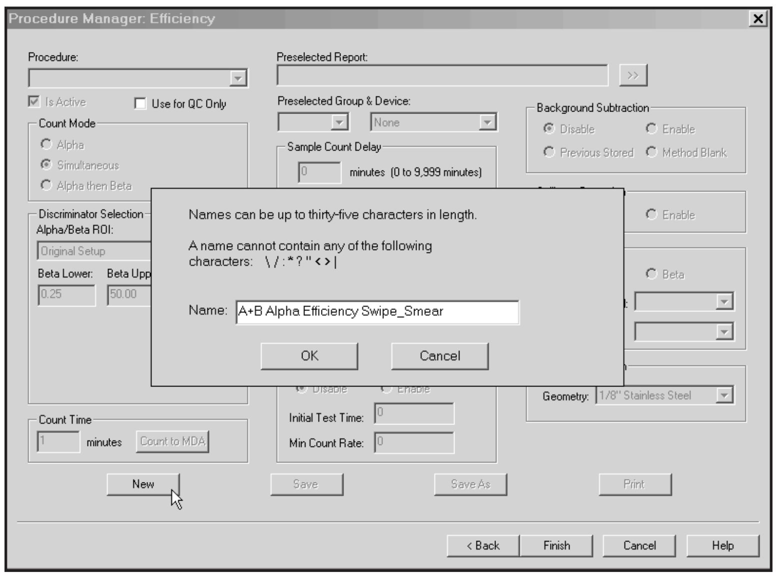


Figure 77 Efficiency Screen with Procedure Name Dialog

The *Procedure Name* can be up to 35 characters long. The symbols, \ / : * ? “ < > and | can not be used in the procedure name. The procedure name should be sufficiently descriptive that you will clearly understand “what this procedure measures”, when choosing it for execution.

Once a name is entered and **OK** is clicked, the procedure name will appear in the *Procedure* list and a message appears: “A standard must be selected before this procedure can be made active”. After clicking on **OK**, the Procedure Manager: Efficiency screen will show this procedure as “inactive”.

Eclipse LB will automatically save this procedure as “inactive” with default values (Figure 78). If these values remain unchanged, click on **Finish** to exit the Procedure Manager or **Back** to return to the initial Procedure Manager screen.

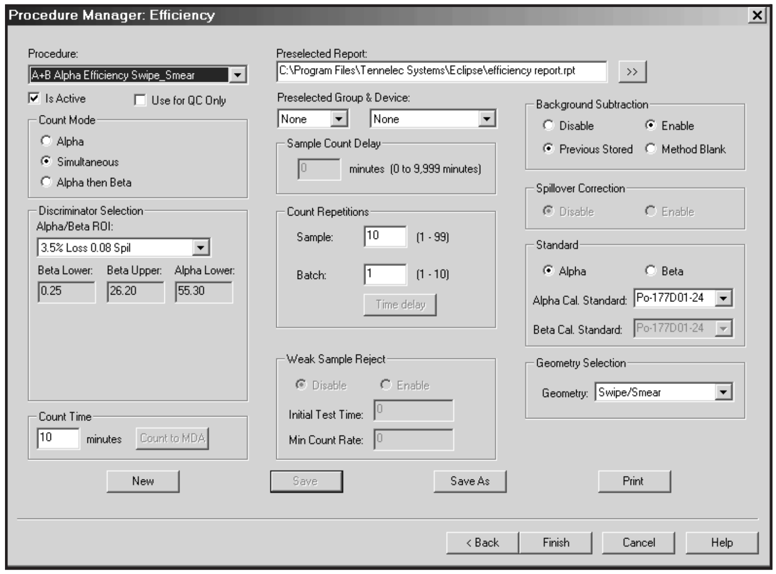


Figure 78 Efficiency Screen

The following options are available for the creation of an efficiency calibration procedure. If any of these options/values are changed, the procedure must be saved once again.

Is Active

Once a Standard has been chosen, selecting this check box will switch this procedure to an “active” status. The default for efficiency calibration procedures is *Inactive*. Inactive procedures are not available for use. Refer to “Standard” on page 84.

Use for QC Only

The default setting is with the check box cleared. Selecting this option allows the procedure to be used with an Auto QC sequence to verify system performance. Use of this procedure in a QC sequence does not change the system calibration.

Count Mode

Three count modes are available for the analysis of unknown samples. If all three modes will be utilized in the analysis of unknown samples, the system must be calibrated for each mode.

Alpha

The Alpha (alpha only) Count Mode sets the system high voltage to the alpha plateau voltage. At this voltage, the proportional counter is only sensitive to alpha radiation.

Simultaneous

The simultaneous count mode sets the system high voltage to the beta plateau voltage. At this voltage, the proportional counter is sensitive to all ionizing radiation and the separation of alpha and beta particles is accomplished using pulse height.

Alpha then Beta

In the alpha then beta mode of operation the sample is counted twice; first at the alpha only voltage and then at the simultaneous voltage. The simultaneous voltage counts are then corrected for the alpha only voltage counts.

Discriminator Selection - Alpha/Beta ROI

Active only for the Simultaneous Count Mode, this selection uses previously determined amplifier settings for the separation of alpha and beta particles. See “Alpha/Beta Amplifier Discriminator Adjustment” on page 53 for a description of the amplifier setup discriminator settings. Default settings for Alpha Only and Alpha then Beta modes are not changeable.

Count Time

Selectable from 0.2 to 9999.0 minutes, live time; default is *1 minute*.

Preselected Report

The default for this procedure option is that no report is selected.

Eclipse LB will automatically print the results of the efficiency procedure if efficiency report.rpt is selected. Make this selection by clicking on the “>>” button. If no report is selected, an efficiency report can be manually printed after the analysis is completed.

Preselected Group & Device

Preselected Group

A through J; default is *None*.

If a Group letter, A through J, is selected from the drop-down list, this efficiency procedure will always search the Tennelec Low Background Counting System for that Group carrier as the location of the efficiency standard. If no Group is selected, the you must make this selection at the time the procedure is initiated.

Preselected Device

Any registered counting system; default is *None*.

If a registered system, Device, is selected, this procedure will only run on that system. If no system is selected, you must make this selection at the time the procedure is initiated. This is most appropriate for computer systems with Eclipse LB operating more than one counting system.

Count Repetitions

Sample

Selectable from 1 to 99; default is “1”.

This is the number of times a sample will be counted for the selected Count Time before the next sample is inserted for analysis.

Batch

Selectable from 1 to 10; default is “1”.

This is the number of times a Batch (Group) of samples will be counted before the system proceeds to another Group or Batch of samples. Note: This option requires firmware version 2.06 or higher.

Background Subtraction

Disable or Enable; default is *Disable*.

Select *Enable* to correct the efficiency data results for background or *Disable* to ignore the contribution of background to the efficiency results.

Standard

Select Alpha or Beta

Every efficiency calibration procedure must have a standard selected before it can be stored as “active”. For procedures that are created for Alpha only count mode, only the Alpha option is active. For Simultaneous and Alpha then Beta count modes, both the alpha and the beta options are active for selection. If an appropriate standard has not yet been entered into the Standards and Nuclides database the efficiency calibration procedure can only be saved as inactive. See “Entering Calibration Standards” on page 42. It can be recalled by clearing the “List active procedures only” check box on the initial Procedure Manager screen and updated to include a standard at a later time.

Geometry Selection

Just as for Count Mode, if multiple geometries will be used in the analysis of unknown samples, the system must be efficiency calibrated for each of those geometries. From the *Geometry* list choose: 1/8” Stainless Steel, ¼” Stainless Steel, 5/16” Stainless Steel, Daily, or Swipe/Smear. Separate procedures must be created for efficiency calibrations for each geometry selection required.

Once all selections and changes have been made, click on **Save** to save this procedure or save it under another name using the **Save As** button. This process can be repeated to prepare all of the efficiency calibration procedures needed. Once this is done, click **Finish** to exit the Procedure Manager or **Back** to return to the initial Procedure Manager screen.

Attenuation Procedure

An attenuation efficiency procedure is used to calibrate a Tennelec Automatic Low Background Alpha/Beta Counting System for the absorption effects of sample mass on the sensitivity, efficiency, of the system.

An attenuation calibration procedure is created by starting the Procedure Manager and clicking on *Attenuation procedure* then **Next**. The Procedure Manager: Attenuation screen is displayed. If no attenuation procedures have been previously created, click on **New** and enter an appropriate procedure name (Figure 79).

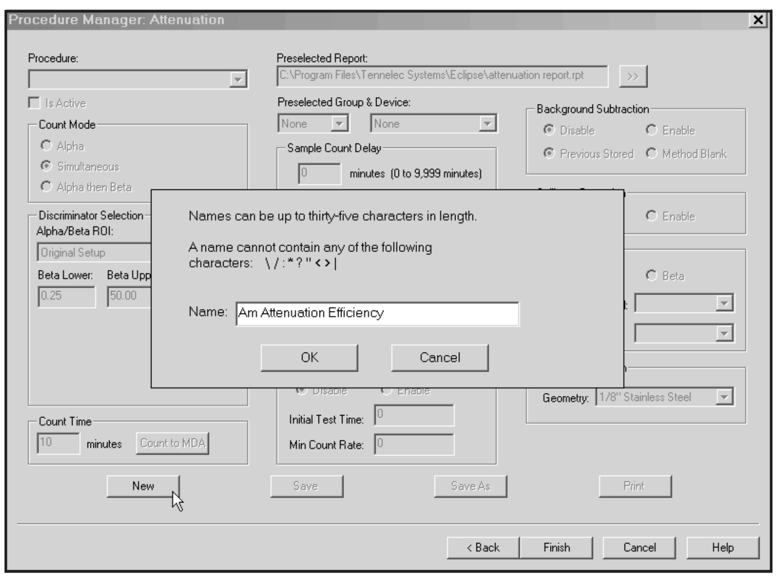


Figure 79 Attenuation Screen with Procedure Name Dialog

The *Procedure Name* can be up to 35 characters long. The symbols, \ / : * ? “ < > and | can not be used in the procedure name. The procedure name should be sufficiently descriptive that you will clearly understand what this procedure measures, when choosing it for execution.

Once a name is entered and **OK** is clicked, the procedure name will appear in the *Procedure* list and a message appears: “A standard must be selected before this procedure can be made active”.

After clicking **OK**, the Procedure Manager: Efficiency screen will show this procedure as “inactive”. Eclipse LB will automatically save this procedure as “inactive” with default values (Figure 80). If these values remain unchanged, click on **Finish** to exit the Procedure Manager or **Back** to return to the initial Procedure Manager screen.

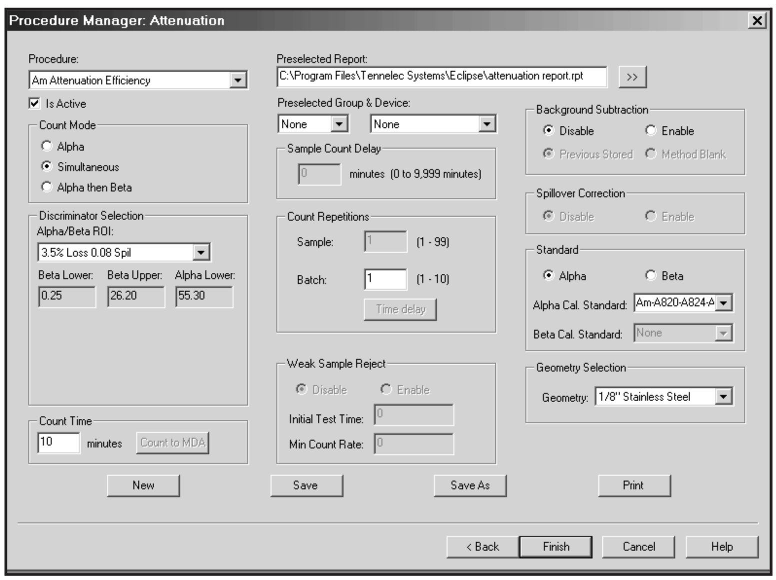


Figure 80 Attenuation Screen

The following options are available for the creation of an efficiency calibration procedure. If any of these options/values are changed, the procedure must be saved once again.

Is Active

Once a Standard has been chosen, selecting this check box will switch this procedure to an “active” status. The default for attenuation calibration procedures is *Inactive*. Inactive procedures are not available for use. Refer to “Standard” on page 88.

Count Mode

Three count modes are available for the analysis of unknown samples. If all three modes will be utilized in the analysis of unknown samples, the system must be calibrated for each mode.

Alpha

The Alpha (alpha only) Count Mode sets the system high voltage to the alpha plateau voltage. At this voltage, the proportional counter is only sensitive to alpha radiation.

Simultaneous

The simultaneous count mode sets the system high voltage to the beta plateau voltage. At this voltage, the proportional counter is sensitive to all ionizing radiation and the separation of alpha and beta particles is accomplished using pulse height.

Alpha then Beta

In the alpha then beta mode of operation the sample is counted twice; first at the alpha only voltage and then at the simultaneous voltage. The simultaneous voltage counts are then corrected for the alpha only voltage counts.

Discriminator Selection - Alpha/Beta ROI

Active only for the Simultaneous Count Mode, this selection uses previously determined amplifier settings for the separation of alpha and beta particles. See “Alpha/Beta Amplifier Discriminator Adjustment” on page 53 for a description of the amplifier setup discriminator settings. Default settings for Alpha Only and Alpha then Beta modes are not changeable.

Count Time

Selectable from 0.2 to 9999.0 minutes, live time; default is 1 minute.

Preselected Report

The default for this procedure option is that no report is selected.

Eclipse LB will automatically print the results of the attenuation procedure if attenuation report.rpt is selected. Make this selection by clicking on the “>>” button. If no report is selected, an attenuation report can be manually printed after the analysis is completed.

Preselected Group & Device

Preselected Group

A through J; default is *None*.

If a Group letter, A through J, is selected from the drop-down list, this attenuation procedure will always search the Tennelec Low Background Counting System for that Group carrier as the location of the efficiency standard. If no Group is selected, you must make this selection at the time the procedure is initiated.

Preselected Device

Any registered counting system; default is *None*.

If a registered system, Device, is selected, this procedure will only run on that system. If no system is selected, you must make this selection at the time the procedure is initiated. This is most appropriate for computer systems with Eclipse LB operating more than one counting system.

Count Repetitions - Batch

Selectable from 1 to 10; default is “1”.

This is the number of times a Batch (Group) of samples will be counted before the system proceeds to another Group or Batch of samples. Note: This option requires firmware version 2.06 or higher.

Background Subtraction

Disable or Enable; default is *Disable*.

Select *Enable* to correct the efficiency data results for background or *Disable* to ignore the contribution of background to the efficiency results.

Standard – Alpha or Beta

Every attenuation calibration procedure must have a standard selected before it can be stored as “active”. For procedures that are created for Alpha only count mode, only the Alpha option is active. For Simultaneous and Alpha then Beta count modes, both the alpha and the beta options are active for selection. If an appropriate standard has not yet been entered into the Standards and Nuclides database the attenuation calibration procedure can only be saved as inactive. See “Entering Calibration Standards” on page 42. It can be recalled by clearing the “List active procedures only” option of the initial Procedure Manager screen and updated to include a standard at a later time.

Geometry Selection

Just as for Count Mode, if multiple geometries will be used in the analysis of unknown samples, the system must be attenuation calibrated for each of those geometries. From the *Geometry* list choose: 1/8” Stainless Steel, ¼” Stainless Steel, 5/16” Stainless Steel, Daily, or Swipe/Smear. Separate procedures must be created for attenuation calibrations for each geometry selection required.

Once all selections and changes have been made, click on **Save** to save this procedure or save it under another name using the **Save As** button. This process can be repeated to prepare all of the attenuation calibration procedures needed. Once this is done, click **Finish** to exit the Procedure Manager or **Back** to return to the initial Procedure Manager screen.

Sample Counting Procedures

Two Sample Counting Procedure templates, Unknown and SMS, are used to analyze samples with Tennelec Automatic Low Background Alpha/Beta Counting Systems.

Unknown Procedure

Unknown procedures are used by Eclipse LB to analyze samples for the presence of alpha or beta emitting isotopes with Tennelec Automatic Low Background Alpha/Beta Counting Systems.

An Unknown procedure is created by starting the Procedure Manager and clicking on *Unknown procedure* and then on **Next.** The Procedure Manager: Unknown screen is displayed. If no unknown procedures have been previously created, click on **New** and enter an appropriate procedure name (Figure 81).

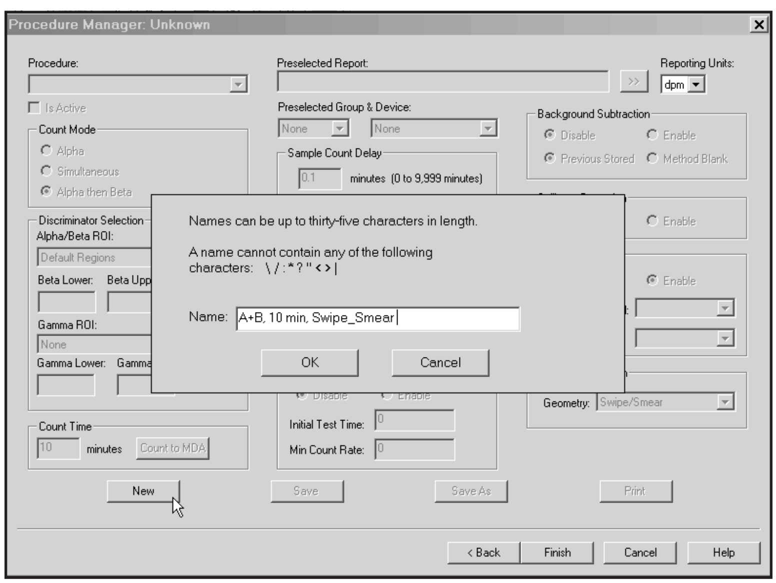


Figure 81 Unknown Screen with Procedure Name Dialog

The *Procedure Name* can be up to 35 characters long. The symbols, \ / : * ? “ < > and | can not be used in the procedure name. The procedure name should be sufficiently descriptive that you will clearly understand “what this procedure measures”, when choosing it for execution.

After clicking on **OK**, the procedure name will then appear in the *Procedure* list. Eclipse LB will automatically save this procedure as “active”, with default values (Figure 82). If these values remain unchanged, click on **Finish** to exit the Procedure Manager or **Back** to return to the initial Procedure Manager screen.

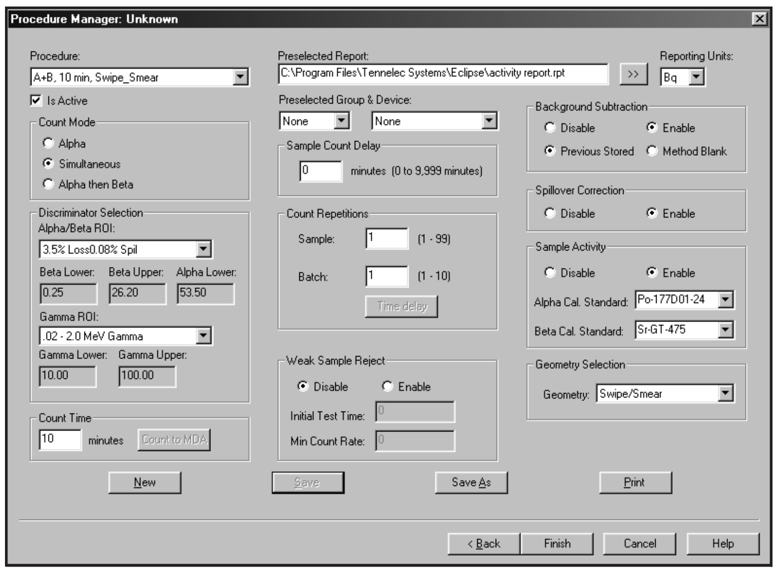


Figure 82 Unknown Procedure Screen

The following options are available for the creation of an unknown sample counting procedure. If any of these options/values are changed, the procedure must be saved once again.

Note: Options with an asterisk are available when the Eclipse software detects an counting system with the gamma detector option installed.

Is Active

Selecting the Is Active check box will change will change an active status to inactive and an inactive status to active. The default for unknown counting procedures is *Active*. Inactive procedures are not available for use.

Count Mode

Three count modes are available for the analysis of unknown samples. When selecting a Count Mode, be certain that the system has been previously calibrated for that mode.

Alpha

The Alpha (alpha only) Count Mode sets the system high voltage to the alpha plateau voltage. At this voltage, the proportional counter is only sensitive to alpha radiation.

Simultaneous

The simultaneous count mode sets the system high voltage to the beta plateau voltage. At this voltage, the proportional counter is sensitive to all ionizing radiation and the separation of alpha and beta particles is accomplished using pulse height.

Alpha then Beta

In the alpha then beta mode of operation the sample is counted twice; first at the alpha only voltage and then at the simultaneous voltage. The simultaneous voltage counts are then corrected for the alpha only voltage counts.

ROI Discriminator Selection

Alpha/Beta ROI

Active only for the Simultaneous Count Mode, this selection uses previously determined amplifier settings for the separation of alpha and beta particles. See “Alpha/Beta Amplifier Discriminator Adjustment” on page 53 for a description of the amplifier setup discriminator settings. Default settings for Alpha Only and Alpha then Beta modes are not changeable.

*Gamma ROI

This selection specifies the energy window of the gamma counting channel. The gamma counting channel operation is independent of the Alpha/Beta channel. See “Gamma Amplifier Discriminator Adjustment” on page 56 for more details.

Count Time

Selectable from 0.2 to 9999.0 minutes, live time; default is *1 minute*.

Preselected Report

The default for this procedure option is that no report is selected.

Eclipse LB will automatically print the results of this unknown sample counting procedure if an appropriate report is selected. Make this selection by clicking on the “>>” button. If no report is selected, a report can be manually printed after the analysis is completed.

Reporting Units

Select from Bq (Bequerels), dpm (disintegrations per minute), pC (picocuries), or µCi (microcuries). When activity report is selected, sample activity will be reported in the units selected.

Preselected Group & Device

Preselected Group

A through J; default is *None*.

If a Group letter, A through J, is selected from the drop-down list, this unknown sample counting procedure will always search the Tennelec Low Background Counting System for that Group carrier as the location of the unknown samples. If no Group is selected, you must make this selection at the time the procedure is initiated.

Preselected Device

Any registered counting system; default is *None*.

If a registered system, Device, is selected, this procedure will only run on that system. If no system is selected, you must make this selection at the time the procedure is initiated. This is most appropriate for computer systems with Eclipse LB operating more than one counting system.

Sample Count Delay

Selectable from 0 to 9999 minutes.

The delay time between counting intervals. If a value other than “0” is entered, the system will count the sample for the selected Count Time, wait for the amount of time selected for the Sample Count Delay and then count the sample again, for the number of Count Repetitions selected.

Count Repetitions

Sample

Selectable from 1 to 99; default is “1”.

This is the number of times a sample will be counted for the selected Count Time before the next sample is inserted for analysis.

Batch

Selectable from 1 to 10; default is “1”.

This is the number of times a Batch (Group) of samples will be counted before the system proceeds to another Group or Batch of samples. Note: This option requires firmware version 2.06 or higher.

Weak Sample Reject

Disable or Enable

This option can be extremely valuable when counting large numbers of samples for long counting times. Generally, a sample count is terminated when the preset counting time is reached. This option allows you to terminate a count if less than a specified number of counts, generally based on background, is acquired within a specified amount of time. This option is *not* available for the Alpha then Beta Count Mode.

Initial Test Time

Eclipse LB will, at this preset time, evaluate the count rate and make a reject or continue decision.

Min Count Rate

If this preset count rate, CPM, is equaled or exceeded within the Initial Test Time, Eclipse LB will continue counting until the Count Time is reached. If this count rate is not equaled, Eclipse LB will terminate the counting of this sample.

Background Subtraction

Disable or Enable

The default is *Disable*. If Background Subtraction is enabled, Eclipse LB will automatically subtract background contributions from the acquired sample data. Two background choices are provided.

Previously Stored

Eclipse LB subtracts the alpha, beta, and gamma background values that were previously determined in the calibration of the system.

Method Blank

If Method Blank is chosen, Eclipse LB will use the alpha, beta, and gamma results of the count of any sample within the Group (Batch) identified as the Background Blank backgrounds and will subtract these results from the counts acquired from the remaining samples in that group. The sample to be used as the background blank can be identified after all of the samples have been counted, by double clicking on the Sample ID. It can also be identified, prior to the counting of the sample, using the Sample Manager. Refer to Chapter 8, *Sample Manager*.

Spillover Correction

Disable or Enable, default is *Disable*.

When performing an efficiency calibration in the Simultaneous Count Mode, Eclipse LB will determine the % of beta interactions that spillover and are stored as alpha events plus the % of alpha interactions that spillover and are stored as beta events. This option is not available for the Alpha Only or the Alpha then Beta Count Modes.

Sample Activity

Disable or Enable; default is *Disable*.

If left disabled, Eclipse LB will only be able to report the results of the sample count in CPM (Counts per Minute). If enabled and appropriate calibration sources are selected, Eclipse LB will correct the counting data for system efficiency and report the results in an activity, as determined by the Preselected Report chosen for this procedure.

Note: The system must be calibrated for the Count Mode, Alpha and Beta Standard and the Geometry Selection selected by this procedure in order to correct for system efficiency.

Geometry Selection

Select the geometry of the samples to be analyzed using this procedure. From the *Geometry* list, choose: 1/8” Stainless Steel, ¼” Stainless Steel, 5/16” Stainless Steel, Daily, or Swipe/Smear. Separate procedures must be created for unknown samples for each geometry selection required.

Once all selections and changes have been made, click on **Save** to save this procedure or save it under another name using the **Save As** button. This process can be repeated to prepare all of the unknown sample counting procedures needed. Once this is done, click **Finish** to exit the Procedure Manager or **Back** to return to the initial Procedure Manager screen.

SMS Procedure

Note: This procedure is available only if the SMS software (previously NFS/RPS software) has been installed on the system computer.

SMS procedures are used by Eclipse LB to analyze samples for the presence of alpha, beta, or gamma emitting isotopes with Tennelec Automatic Low Background Alpha/Beta Counting Systems. The results of these analysis are stored in the Eclipse LB database and copied to the Sample Management System database for further analysis. SMS procedures are identical to Unknown procedures.

Creating an SMS procedure is created by starting the Procedure Manager and clicking on *SMS procedure* and then on **Next**. The Procedure Manager: SMS screen is displayed. If no SMS procedures have been previously created, click on **New** and enter an appropriate procedure name (Figure 83).

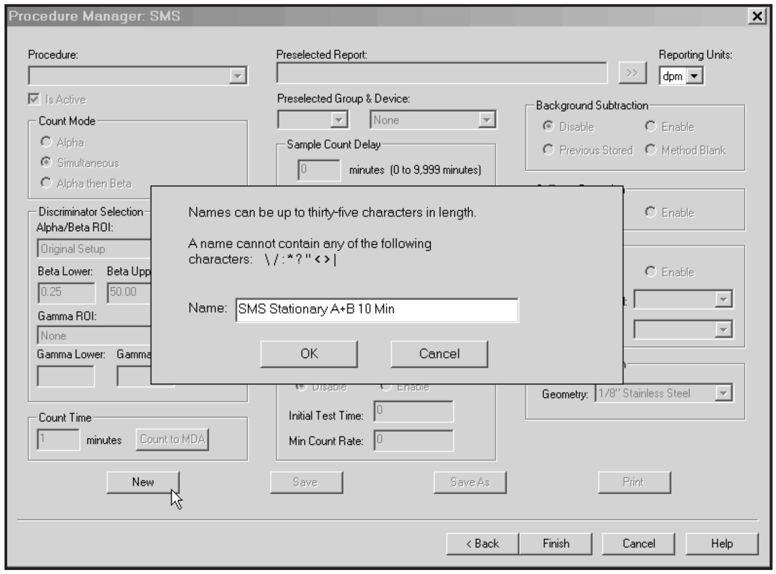


Figure 83 SMS Screen with Procedure Name Dialog

The *Procedure Name* can be up to 35 characters long. The symbols, \ / : * ? “ < > and | can not be used in the procedure name. The procedure name should be sufficiently descriptive that you will clearly understand “what this procedure measures”, when choosing it for execution.

After clicking **OK**, the procedure name will then appear in the *Procedure* list. Eclipse LB will automatically save this procedure as “active” with default values (Figure 84). If these values remain unchanged, the click on **Finish** to exit the Procedure Manager or **Back** to return to the initial Procedure Manager screen.

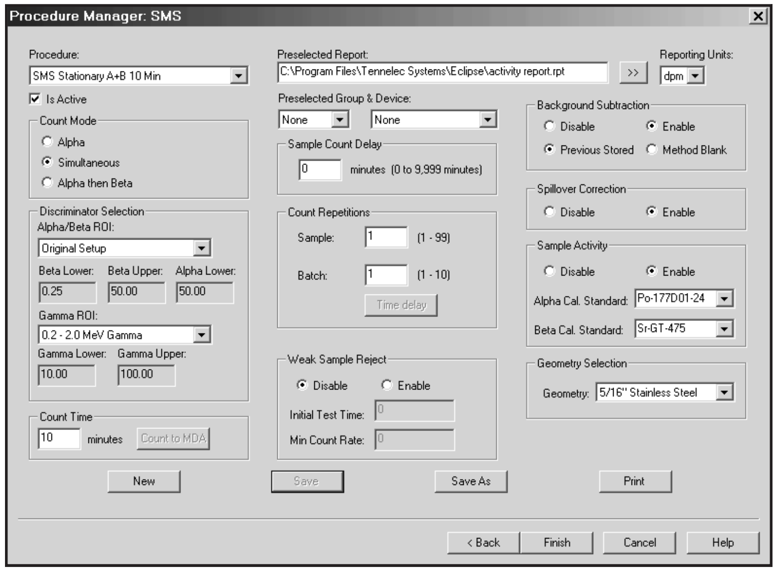


Figure 84 SMS Procedure Screen

The following options are available for the creation of an SMS sample counting procedure. If any of these options/values are changed, the procedure must be saved once again.

Note: Options with an asterisk are available when the Eclipse software detects an counting system with the gamma detector option installed.

Is Active

Selecting the Is Active check box will change will change an active status to inactive and an inactive status to active. The default for SMS counting procedures is *Active*. Inactive procedures are not available for use.

Count Mode

Three count modes are available for the analysis of unknown samples. When selecting a Count Mode, be certain that the system has been previously calibrated for that mode.

Alpha

The Alpha (alpha only) Count Mode sets the system high voltage to the alpha plateau voltage. At this voltage, the proportional counter is only sensitive to alpha radiation.

Simultaneous

The simultaneous count mode sets the system high voltage to the beta plateau voltage. At this voltage, the proportional counter is sensitive to all ionizing radiation and the separation of alpha and beta particles is accomplished using pulse height.

Alpha then Beta

In the alpha then beta mode of operation the sample is counted twice; first at the alpha only voltage and then at the simultaneous voltage. The simultaneous voltage counts are then corrected for the alpha only voltage counts.

ROI Discriminator Selection

Alpha/Beta ROI

Active only for the Simultaneous Count Mode, this selection uses previously determined amplifier settings for the separation of alpha and beta particles. See “Alpha/Beta Amplifier Discriminator Adjustment” on page 53 for a description of the amplifier setup discriminator settings. Default settings for Alpha Only and Alpha then Beta modes are not changeable.

*Gamma ROI

This selection specifies the energy window of the gamma counting channel. The gamma counting channel operations is independent of the Alpha/Beta channel. See “Gamma Amplifier Discriminator Adjustment” on page 56 for more details.

Count Time

Selectable from 0.2 to 9999.0 minutes, live time; default is *1 minute*.

Preselected Report

The default for this procedure option is that no report is selected.

Eclipse LB will automatically print the results of this unknown sample counting procedure if an appropriate report is selected. Make this selection by clicking on the “>>” button. If no report is selected, a report can be manually printed after the analysis is completed.

Reporting Units

Select from Bq (Bequerels), dpm (disintegrations per minute), pC (picocuries), or µCi (microcuries). When activity report is selected, sample activity will be reported in the units selected.

Preselected Group & Device

Preselected Group

A through J; default is *None.*

If a Group letter, A through J, is selected from the drop-down list, this unknown sample counting procedure will always search the Tennelec Low Background Counting System for that Group carrier as the location of the unknown samples. If no Group is selected, you must make this selection at the time the procedure is initiated.

Preselected Device

Any registered counting system; default is *None*.

If a registered system, Device, is selected, this procedure will only run on that system. If no system is selected, you must make this selection at the time the procedure is initiated. This is most appropriate for computer systems with Eclipse LB operating more than one counting system.

Sample Count Delay

Selectable from 0 to 9999 minutes.

The delay time between counting intervals. If a value other than “0” is entered, the system will count the sample for the selected Count Time, wait for the amount of time selected for the Sample Count Delay and then count the sample again, for the number of Count Repetitions selected.

Count Repetitions

Sample

Selectable from 1 to 99; default is “1”.

This is the number of times a sample will be counted for the selected Count Time before the next sample is inserted for analysis.

Batch

Selectable from 1 to 10; default is “1”

This is the number of times a Batch (Group) of samples will be counted before the system proceeds to another Group or Batch of samples. Note: This option requires firmware version 2.06 or higher.

Weak Sample Reject

Disable or Enable

This option can be extremely valuable when counting large numbers of samples for long counting times. Generally, a sample count is terminated when the preset counting time is reached. This option allows you to terminate a count if less than a specified number of counts, generally based on background, is acquired within a specified amount of time. This option is *not* available for the Alpha then Beta Count Mode.

Initial Test Time

Eclipse LB will, at this preset time, evaluate the count rate and make a reject or continue decision.

Min Count Rate

If this preset count rate, CPM, is equaled or exceeded within the Initial Test Time, Eclipse LB will continue counting until the Count Time is reached. If this count rate is not equaled, Eclipse LB will terminate the counting of this sample.

Background Subtraction

Disable or Enable

The default is *Disable*. If Background Subtraction is enabled, Eclipse LB will automatically subtract background contributions from the acquired sample data. Two background choices are provided.

Previously Stored

Eclipse LB subtracts the alpha, beta, and gamma background values that were previously determined in the calibration of the system.

Method Blank

If Method Blank is chosen, Eclipse LB will use the alpha, beta, and gamma results of the count of any sample within the Group (Batch) identified as the Background Blank backgrounds and will subtract these results from the counts acquired from the remaining samples in that group. The sample to be used as the background blank can be identified after all of the samples have been counted, by double clicking on the Sample ID. It can also be identified, prior to the counting of the sample, using the Sample Manager. Refer to Chapter 8, *Sample Manager*.

Spillover Correction

Disable or Enable; default is *Disable*.

When performing an efficiency calibration in the Simultaneous Count Mode, Eclipse LB will determine the % of beta interactions that spillover and are stored as alpha events plus the % of alpha interactions that spillover and are stored as beta events. This option is not available for the Alpha Only or the Alpha then Beta Count Modes.

Sample Activity

Disable or Enable; default is *Disable*.

If left disabled, Eclipse LB will only be able to report the results of the sample count in CPM (Counts per Minute). If enabled and appropriate calibration sources are selected, Eclipse LB will correct the counting data for system efficiency and report the results in an activity, as determined by the Preselected Report chosen for this procedure.

Note: The counting system must be calibrated for the Count Mode, Alpha and Beta Standard and the Geometry Selection selected by this procedure in order to correct for system efficiency.

Geometry Selection

Select the geometry of the samples to be analyzed using this procedure. From the *Geometry* list, choose: 1/8” Stainless Steel, ¼” Stainless Steel, 5/16” Stainless Steel, Daily, or Swipe/Smear. Separate procedures must be created for SMS samples for each geometry selection required.

Once all selections and changes have been made, click on **Save** to save this procedure.

Note: If Sample Activity is enabled, but no standards are selected, Eclipse LB will display a warning message: “No alpha standard has been selected. This procedure will be marked inactive.” when the **Save** button is clicked.

Once standards are selected, the Is Active check box is selected and the procedure is saved once again or save it under another name using the **Save As** button. This process can be repeated to prepare all of the SMS sample counting procedures needed. Once this is done, click **Finish** to exit the Procedure Manager or **Back** to return to the initial Procedure Manager screen.

6. Archiving Batch Data

The archiving batch data feature of Eclipse provides the system operator with the ability to reduce the size of the Eclipse Microsoft Access database, Eclipse.mdb, and thus reduce the time required to print reports and perform other database searches.

There are three archiving options. They are: Create an Archive, View an Archive, and Delete Batches. These archiving options may be accessed using **DB Utilities** in the menu bar or by clicking on the Archive button in the Toolbar. These options are available only when no batch data is displayed.

Creating an Archive

The Archive screen (Figure 85) allows you to select batches to archive based on the Device, Procedure type, and/or a Batch Date/time Range.

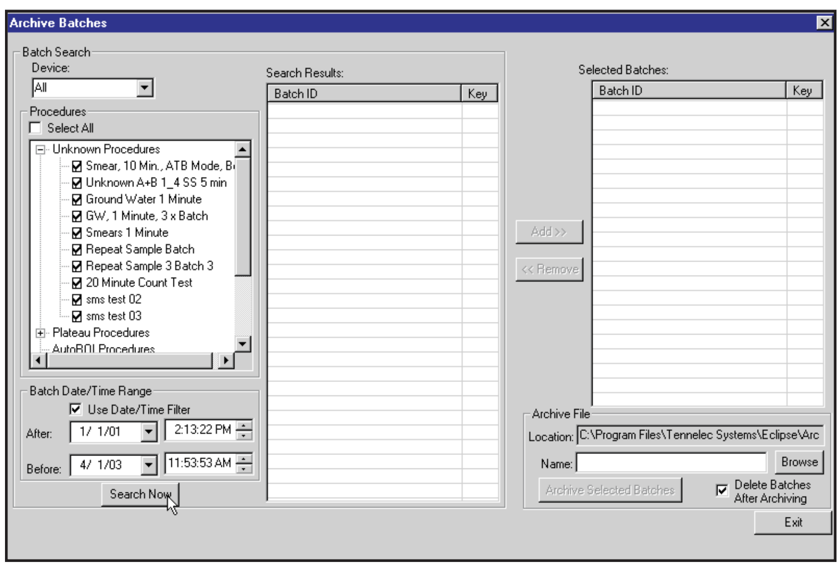


Figure 85 Creating an Archive

Batch Search

Device

If multiple devices are attached to the same computer, the system operator may select procedures to archive from one of these devices or all of the devices.

Procedures

You can check the Select All Procedures or you can limit the search to only those batches that use a specific counting procedure.

The batch data from background, efficiency, spillover, attenuation and plateau calibration procedures that are marked “Is Current” will not be available for archiving. For calibration procedures that are not marked “Is Current”, the batch data will be archived but the record of those procedures will be retained in the active database.

Date/Time Range Section

If the Use Date/Time Filter checkbox is selected, the Search will identify only those batches from the selected procedures within the Before and After date and time range specified.

Search Now

Click the **Search Now** button to start a search of batches matching the search criteria (Figure 86).

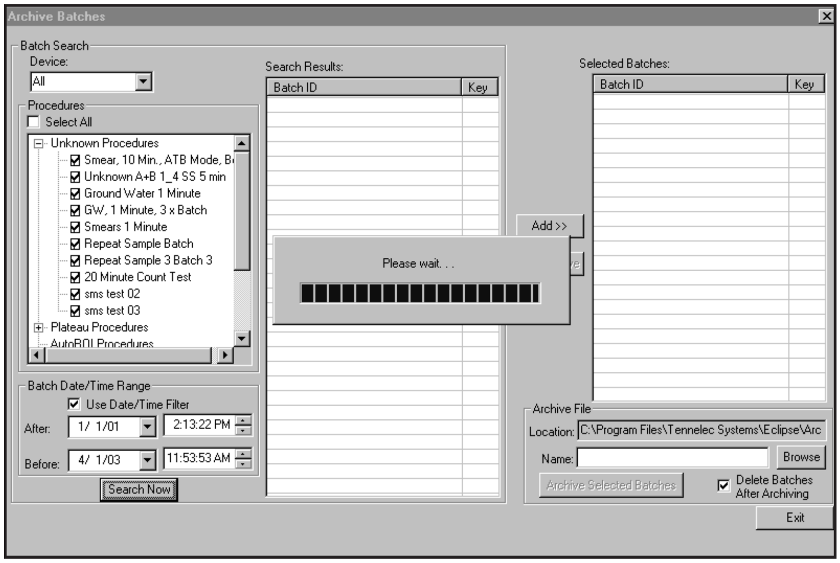


Figure 86 Performing a Search

Search Results

When the database search is completed, the Search Results pane displays all the batches that fall in the search criteria selected above.

Add

To add a batch in the Search Results pane to the Selected Batch pane, highlight the batch and press the **Add>** button. To add all of the batches in the Search Results pane, left mouse click on the first batch, top of the list, scroll down to the last batch and while holding down the Shift key, left mouse click on the last batch.

Remove

To remove a batch from the Selected Batches pane, highlight the batch(s) to be removed and press the **<Remove** button.

Archive File

Location

The default location for archived files is c:\Program Files\Tennelec Systems\Eclipse\Archive. The Archive folder will be created when Archive Selected Batches is first run. Use the **Browse** button to select a different location or different folder for the archive file.

Name

Enter the name of the file to be archived. This name should be unique and allow you to correctly select this file, versus other files archived later.

Delete Batches After Archiving

This checkbox determines if the batch records being archived should also be deleted from the active database. The default is checked.

If checked, only records from the Batch, Sample Aliquots, LB Analysis Data, and LB Acquisition Data tables will be deleted from the active database once they are archived. Any additional records from the LB Procedures, LB51 Count Profiles, LB Analysis Profiles, LB Regions, Detectors, Devices, Background, Efficiency, and Spillover tables associated with an archived batch will be copied to the archive database but *not* deleted from the active database regardless if this field is checked or not.

Archive Selected Batches

Use **Archive Selected Batches** button to the archive the records displayed in the Selected Batches pane. Once the archive is initiated a progress bar will appear to indicate that archiving is in progress (See Figure 87).

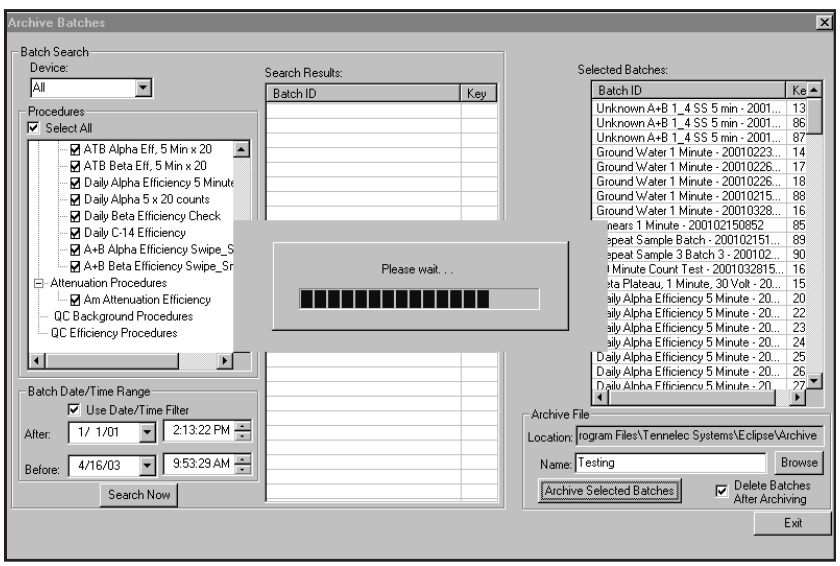


Figure 87 Archiving in Process

Exit

Click this button to leave this screen and return to the Eclipse Main Screen.

Viewing an Archive

The View an Archive option allows you to select a previously created archived database and view batches in that database. From the Open dialog box (Figure 88) select the batch file to open.

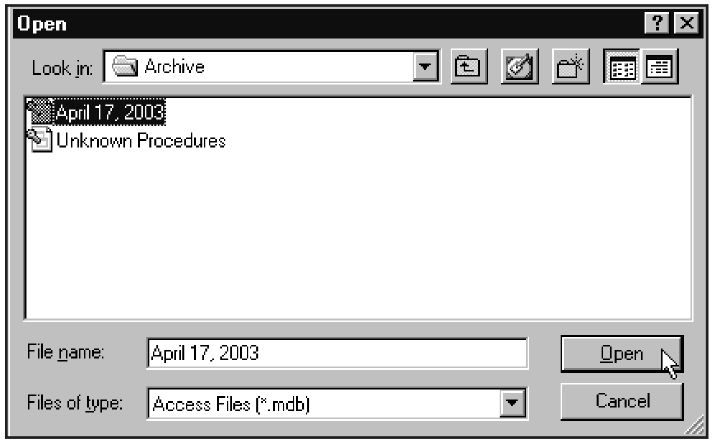


Figure 88 Open the Archive File

The batch data is now displayed. You can print reports and access the Eclipse menu options (Figure 89).

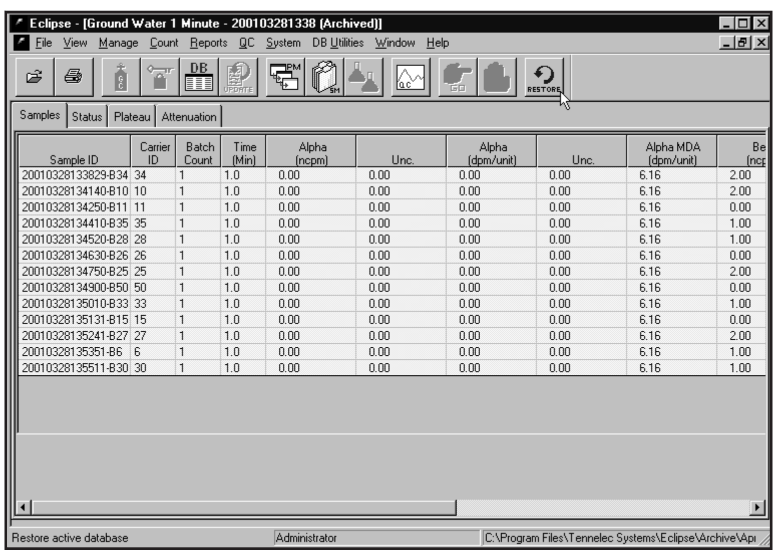


Figure 89 Displaying Archived Batch Data

Selecting the Restore toolbar button will close all the open batches and return you to the active database and restore all the user defined security access rights.

Deleting Batches

The Delete Batches option allows you to select batches, in the active database only, to delete based on the device, procedure type, and/or a date/time range.

Note: You can not archive data from this screen. All selected records will be *permanently deleted* from the database. The same procedure used to archive batches is used to search and then select batches for deletion.

Delete Selected Batches

Use the **Delete Selected Batches** button to delete the records displayed in the Selected Batches pane. After selecting this button a message will be displayed prompting the user to confirm the deletion of the selected batches (Figure 90).

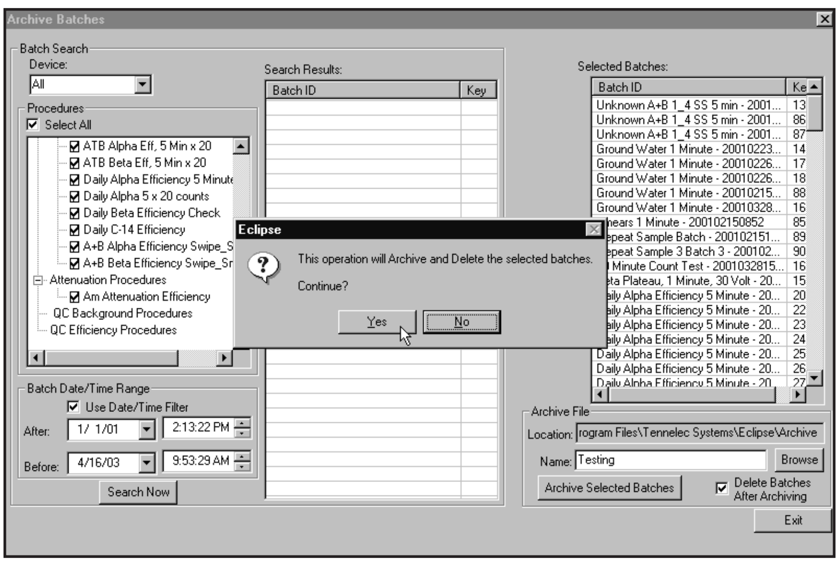


Figure 90 Deleting Selected Batches

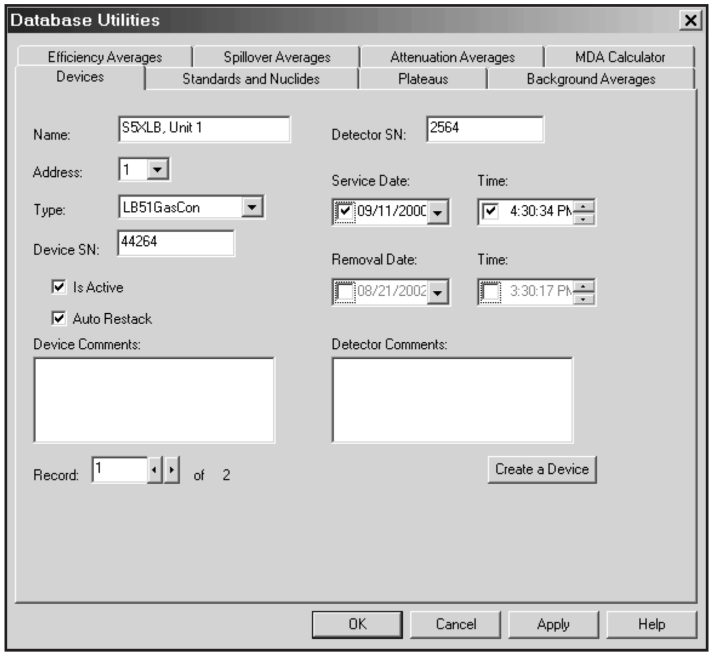


Figure 91 Creating a Device

The following entries and options are provided for the registration of a Tennelec automatic low background alpha/beta counting system/device.

Name

You should enter a name descriptive of the Tennelec system being registered. This name becomes most important when more than one device/system is to be controlled by the same computer.

Address

This is the IEEE interface address (1 through 15) of the Tennelec system. All Tennelec systems are shipped with the IEEE address 1. If multiple systems are to be controlled by the same computer, system addresses must be changed so that each system has a unique IEEE address.

Type

Eclipse LB will operate current and earlier upgraded versions of Tennelec automatic low background systems. The type of system to be registered must be identified. Tennelec model LB5100 Series I, II, III, IV, W and Z should be entered as “LB51" type. Series 5 XLB systems and Series 5 HP systems with Gas Stat should be entered as ”LB51GasCon" type. Series 5 HP systems without Gas Stat should be entered as “LB51GasMode” type.

Device SN

It is recommended that the system serial number be entered in this location for future reference by the system operator or field service engineer.

Is Active

The default setting for this check box is to be selected. *Active*, selected, systems are available for the execution of procedures. If a system that has been registered is taken out of service, this check box can be cleared thus removing it from the list of available systems for procedures.

Auto Restack

The default setting for this check box is to be selected (active). When a Tennelec Automatic Low Background System has completed the analysis of all samples, it will restack the samples to the “send” (right side) stack. If cleared, the samples will be left in the “receive” (left side) stack.

Device Comments

This entry field is provided for you to add any comments appropriate to this system. Canberra recommends that you enter Preventive Maintenance (PM) dates and actions taken in this space.

Detector SN

Enter the detector serial number in this entry field. All calibration values for Tennelec Low Background Systems are stored by Eclipse LB with reference to the Device Name and Detector SN used to generate those values. This option allows for the control of multiple systems by one computer. Also, if a system detector must be replaced, the original Device can be terminated and a new device with the same name, IEEE address, etc., but with a new detector serial number can be created.

Note: When running the Eclipse LB QC Chart program, this detector serial number is used to select the data to be plotted.

Service Date / Time

This entry field is provided to identify when this system was placed into service.

Removal Date/Time

This entry field is provided to identify when this system was taken out of service.

Detector Comments

This entry field is provided to add any comments appropriate to the detector installed in this system.

Once all of the selections have been made, click **Apply** to register this device. Additional devices can be registered by clicking on the **Create a Device** button. Click on **OK** to exit this database or click on the tab of another database to continue.

Standards and Nuclides

The Standards and Nuclides screen (Figure 92) provides you with a convenient method of entering standards for system calibration and to edit or add nuclides. This screen is accessed by clicking **Add/Edit Standards/Nuclides** or the *Standard and Nuclide* tab. Eclipse LB will automatically half-life decay correct the standard activity at the time an analysis is made. Click on **New Standard** to enter a standard.

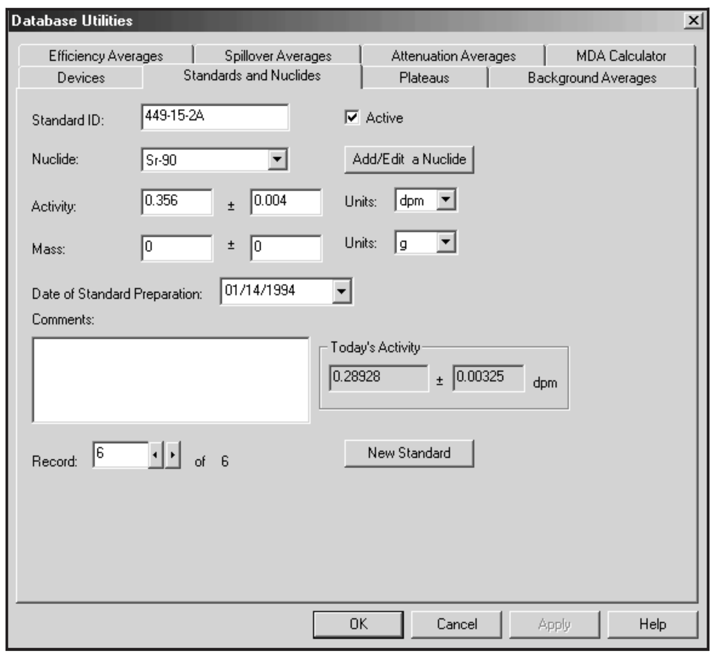


Figure 92 Standards and Nuclides Screen

The following items are provided to enter standards and add or edit nuclides.

Standard ID

This is the identifying name that will be listed when creating procedures to calibrate the system or to correct the analysis data for system efficiency. A nuclide specific name is recommended.

Nuclide

The following twenty-four (24) nuclides are listed by Eclipse LB for selection.

Ac-228	Fe-55	Pa-234	Sr-90
Am-241	I-125	Po-210	Tc-99
C-14	I-129	Pu-238	Th-228
Co-57	I-131	Pu-239	Th-230
Co-60	Ni-63	Ra-226	U-235
Cs-137	Np-239	Ra-228	U-238

Highlight and click on the appropriate nuclide for selection.

Activity

Three input areas are provided. The first is for the activity of the standard, the second for the activity error and the third for the activity units. You can choose between Bq (Bequerels), dpm (disintegrations per minute) and pCi (picocuries) µCi (microcuries) for the standard activity.

Mass

Three input areas are provided. The first is for the mass of the standard, the second for the mass error and the third for the mass units. You can choose between g (grams), kg (kilograms) and mg (milligrams) for the standard mass. Note: This information, although of potential value to the system operator, is not utilized by Eclipse LB.

Date of Standard Preparation

The calibration date should be entered in this space in a mm/dd/yy format. The pull-down calendar can be used to input the calibration date (Figure 93). Eclipse LB assumes a 12:00 midnight time for this activity calibration.

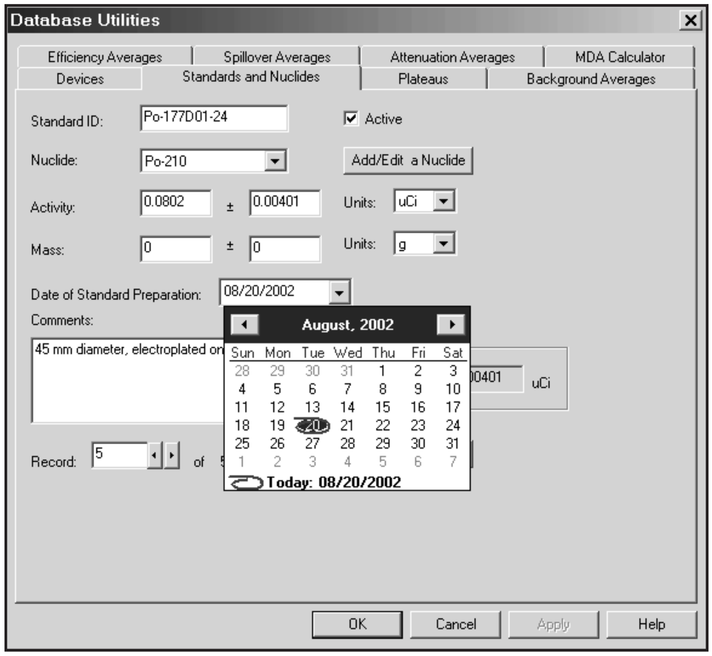


Figure 93 Entering the Calibration Date

Comments

This entry field is provided for the input of information about the standard.

Today's Activity

The half-life decay activity at the time an analysis is made.

Active

This check box is automatically selected when a standard is entered into the Eclipse LB database. If a standard is taken out of service, this box can be cleared, making the source unavailable for the creation of calibration or unknown sample analysis procedures.

Add/Edit a Nuclide

Clicking on this button displays the Nuclear Library dialog box which allows you to either edit an existing nuclide or enter a new nuclide. Use the Record left or right arrows to access the nuclide to be edited or click on **Add** to add a nuclide to the list (Figure 94).

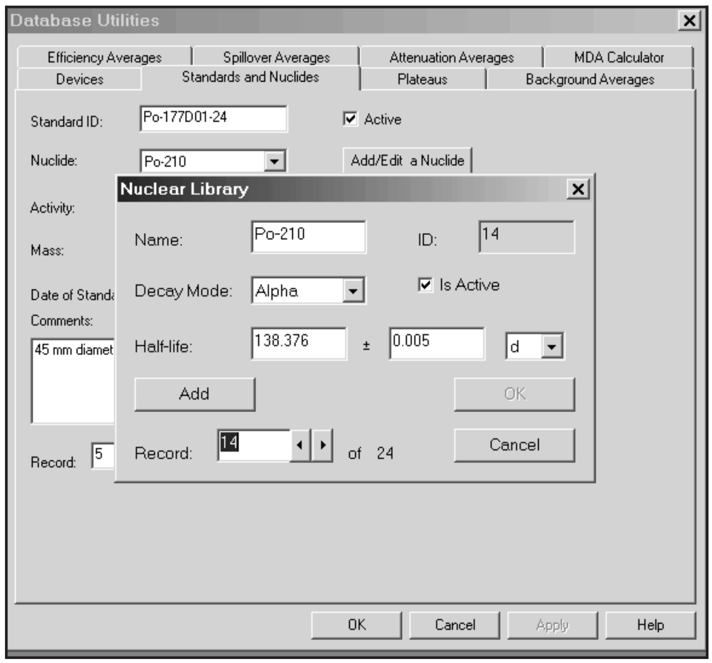


Figure 94 Adding/Editing a Nuclide

The following entries are available when entering a new nuclide or editing an existing nuclide.

Name

The name of the new nuclide should be entered in this space.

Decay Mode

From the drop-down list select alpha, beta or gamma.

Half-life

Three boxes are provide for the half-life of the nuclide, the error and the units in d (days), m (minutes), s (seconds) or y (years).

Is Active

This check box is automatically selected when a nuclide is entered. If cleared, this nuclide will no longer be available for selection when entering a standard.

Once all of the properties of a standard have been entered click **Apply** to save them. When the last standard has been entered and/or nuclide added or edited you can exit the Eclipse LB Database Utilities by clicking **OK** or on the tab of another screen to continue.

Plateaus

The Plateau tab will display the results of calibration plateaus run on this system. This screen is accessed by clicking **Edit Plateaus** or the *Plateaus* tab. If no plateaus have been run, a message appears: “There were no records found in the Plateaus table”. Click **OK** to continue.

If plateaus have bee run on this system, the Plateau screen will appear (Figure 95).

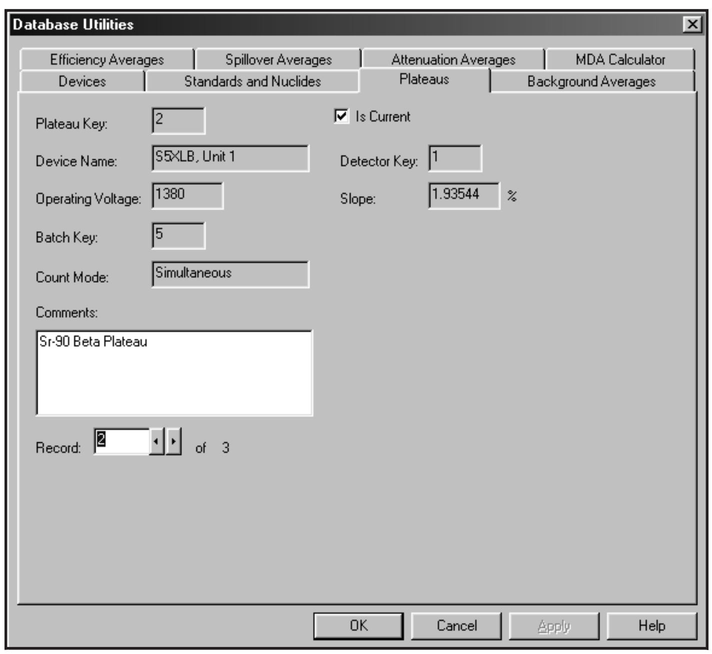


Figure 95 Plateaus Screen

This screen displays the following information about this plateau record.

Plateau Key

This refers to the location of the plateau data in the Plateaus table of the Eclipse LB Microsoft Access database, Eclipse.mdb.

Device Name

This is the name given when registering the system used to generate this plateau. See “Devices” on page 107.

Operating Voltage

The voltage listed determined by Eclipse LB to be the operating voltage for the type of plateau displayed. In this example, this is the alpha only operating voltage.

Batch Key

This identifies the location of this plateau data in the Batch table of the Eclipse LB Microsoft Access database, Eclipse.mdb.

Count Mode

This is the count mode used with the Tennelec LB system to generate this plateau.

Comments

This entry field is provided for the convenience, information pertinent to this plateau can be entered for this record.

Is Current

Whenever a new plateau is generated, Eclipse LB will store the results of that plateau as *Current*. All previous plateaus of the same type will be stored as not current. You can clear any plateau and select a previous plateau. Only one plateau per type, Count Mode, can be current.

Detector Key

This is the location of the detector information associated with the device used to generate this plateau. This location is stored in the Detectors table of the Eclipse LB Microsoft Access database, Eclipse.mdb.

Slope

This is the calculated slope per 100 volts at the Operating Voltage listed.

Record

This displays the number of the record displayed plus how many plateau records are stored in the Eclipse LB database.

Once all plateau selections have been made click **OK** to exit the Eclipse LB Database Utilities or another tab to continue.

Background Averages

The Background Averages tab will display the results of calibration background runs performed on this system. This screen is accessed by clicking **Edit Background Averages** or the *Background Averages* tab. If no backgrounds have been run, a message appears: “There were no records found in the Background Values table”. Click **OK** to continue.

Once a background procedure has been run on this system, the Background Averages screen will appear (Figure 96).

Note: Options with an asterisk are available when the Eclipse software detects an counting system with the gamma detector option installed.

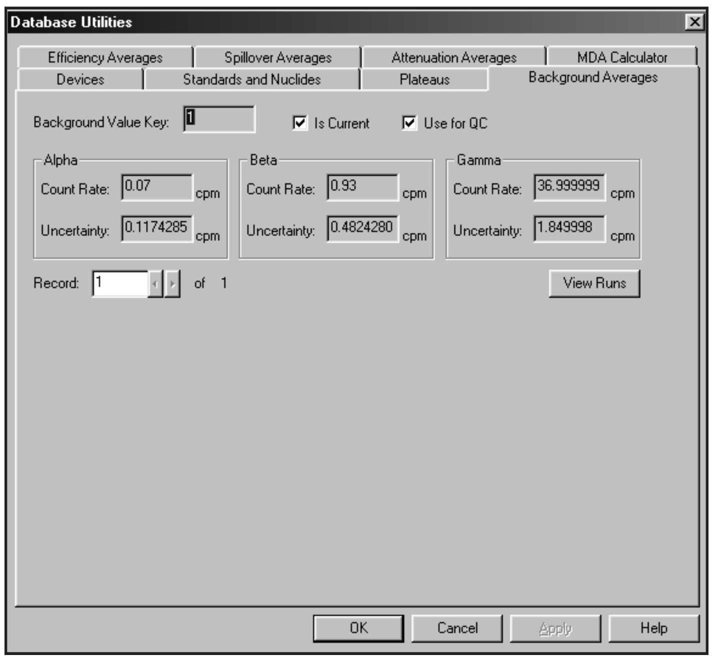


Figure 96 Background Averages Screen

This screen displays the following information about the background average displayed.

Background Value Key

This refers to the location of the background data in the Background Values table of the Eclipse LB Microsoft Access database, Eclipse.mdb.

Is Current

Whenever a background calibration procedure is run, Eclipse LB will store the results of that background count as *Current*. All previous background runs of the same type (count mode and geometry) will be stored as not current. You can clear any background and select a previous background, but only one background per count mode and geometry combination can be current.

Use for QC

Eclipse LB provides you with a QC Chart program in order to verify the continuing performance of a system. This QC Chart program uses the results of efficiency and background counts to make this determination. All background counts are checked for use with this QC program. If the you do not want a specific background count to be used for this test, this check box can be cleared.

Alpha

Count Rate and Uncertainty

These values display the alpha background determined by this count and the uncertainty of that background value.

Beta

Count Rate and Uncertainty

These values display the beta background determined by this count and the uncertainty of that background value.

*Gamma

Count Rate and Uncertainty

These values display the gamma background determined by this count and the uncertainty of that background value.

Record

This displays the record displayed plus how many background records are stored in the Eclipse LB database.

View Runs

Clicking on this button will display the Runs data associated with this Background Average (Figure 97). Displayed in this Runs table are: the Acquisition Date, Geometry, Alpha Count Rate, Uncertainty, Beta Count Rate, Uncertainty, Gamma Count Rate, Uncertainty, Run Key, Detector Key, Count Mode, Sample Aliquot Key and Use for QC.

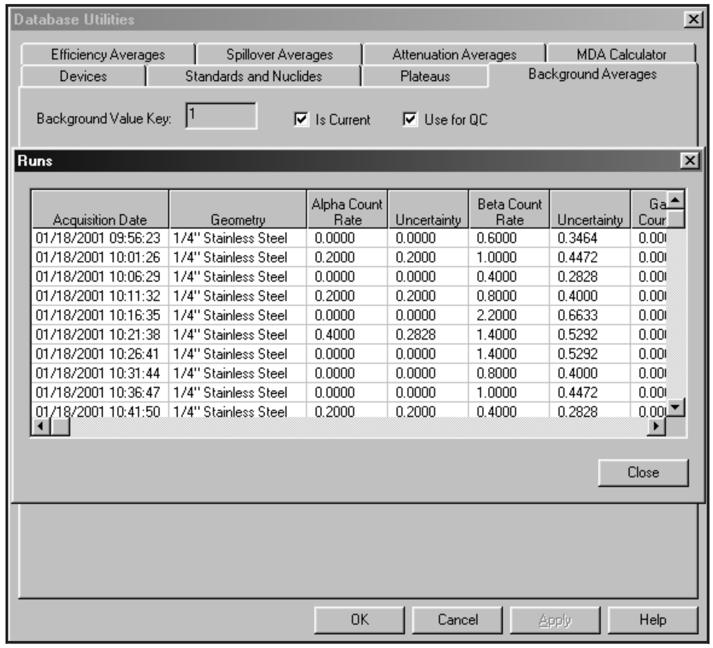


Figure 97 Displaying the Background Data

Use the navigation buttons to move through this table. Click **Close** when finished. Click **OK** to exit the Eclipse LB Database Utilities or another tab to continue.

Efficiency Averages

The Efficiency Averages tab will display the results of calibration efficiency runs performed on this system. This screen is accessed by clicking **Edit Efficiency Averages** or the *Efficiency Averages* tab. If no efficiencies have been run, a message appears: “There were no records found in the Efficiency Values table”. Click **OK** to continue.

Once an efficiency procedure has been run on this system, the Efficiency Averages screen will appear (Figure 98).

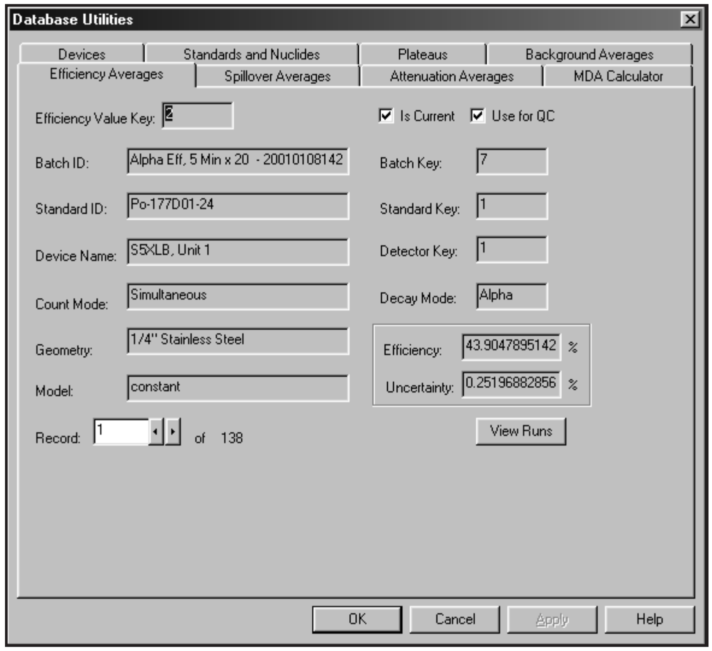


Figure 98 Efficiency Averages Screen

This screen displays the following information about the efficiency average displayed.

Efficiency Value Key

This refers to the location of the efficiency data in the Efficiency Values table of the Eclipse LB Microsoft Access database, Eclipse.mdb.

Is Current

Whenever an efficiency calibration procedure is run, Eclipse LB will store the results of that efficiency count as *Current*. All previous efficiency runs that are of the same type (count mode and geometry) and for the same device and detector will be stored as not current. You can clear any efficiency and select a previous efficiency to be used as current. Only one efficiency value per count mode, geometry, device and detector combination can be current.

Use for QC

Eclipse LB provides you with a QC Chart program in order to verify the continuing performance of a system. This QC Chart program uses the results of efficiency and background counts to make this determination. All efficiency counts are checked for use with this QC program. If you do not want a specific efficiency count to be used for this test, this check box can be cleared.

Batch ID

The name of the procedure used to generate this data plus the sample identification of the first sample of this batch.

Batch Key

This identifies the location of this batch in the Batch table of the Eclipse LB Microsoft Access database, Eclipse.mdb.

Standard ID

The Standard ID of the source used to generate this efficiency calibration value is listed in this entry field.

Standard Key

Identifies the location of this standard in the Standards table of the Eclipse LB Microsoft Access database, Eclipse.mdb.

Device Name

This is the name of the device used to generate this efficiency calibration value.

Detector Key

Identifies the location of this detector in the Detectors table of the Eclipse LB Microsoft Access database, Eclipse.mdb.

Count Mode

This is the Eclipse LB count mode (alpha only, alpha then beta or simultaneous) used to generate this efficiency value.

Decay Mode

This identifies the standard as an alpha or beta emitter.

Geometry

This is the geometry selected when performing this efficiency calibration.

Model

This identifies the model used as a reference in the analysis of unknown samples. For standard efficiency calibrations this will be listed as “constant”. For attenuation efficiency calibrations, the geometric model used to fit the data (Exponential, Linear, Inverse Linear or Inverse Quadratic) will be listed here. See “Attenuation Averages” on page 125.

Efficiency

This entry field displays the result of this efficiency calibration, in percent.

Uncertainty

Displays the calculated uncertainty of the efficiency value listed.

Record

Displays the number of the record displayed plus how many efficiency records are stored in the Eclipse LB database.

View Runs

Clicking on this button will display the Runs data associated with this Efficiency Average (Figure 99). Displayed in this Runs table are: Acquisition Date, Geometry, Efficiency %, Uncertainty %, Run Key, Sample Aliquot Key and Use for QC.

Use the navigation buttons to move through this table. Click **Close** when finished. Click **OK** to exit the Eclipse LB Database Utilities or another tab to continue.

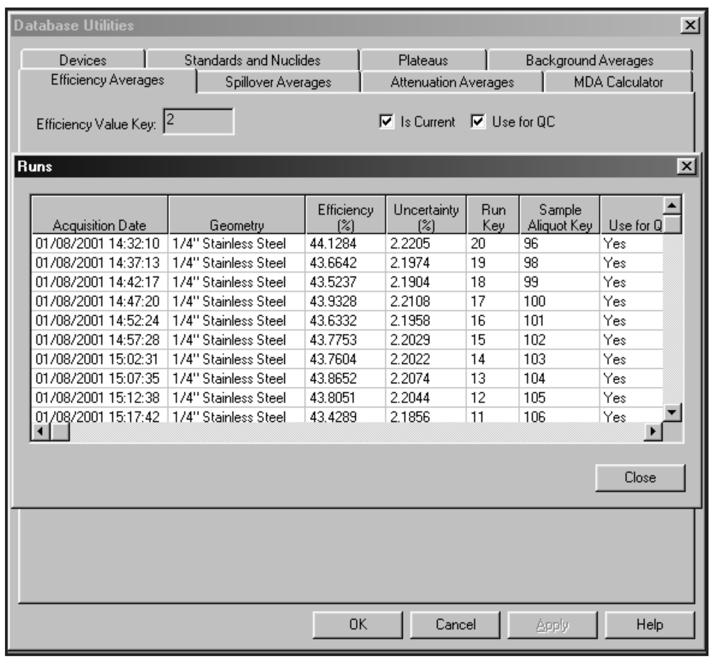


Figure 99 Displaying the Efficiency Data

Spillover Averages

The Spillover Averages tab will display the spillover results determined during efficiency calibrations performed on this system. This screen is accessed by clicking **Edit Spillover Averages** or the *Spillover Averages* tab. If no spillover values have been determined, a message appears: "There were no records found in the Spillover Values table". Click **OK** to continue.

Once an efficiency procedure has been run on this system, the Spillover Averages screen will appear (Figure 100).

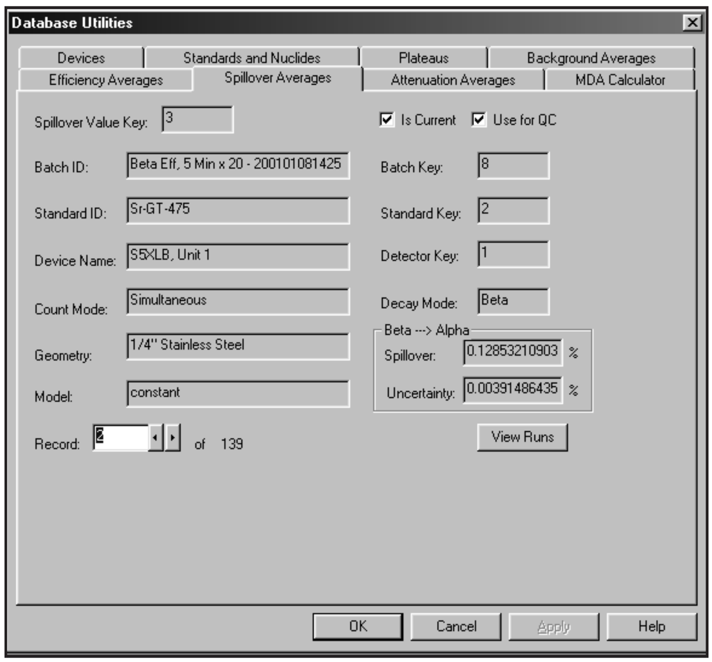


Figure 100 Spillover Averages Screen

This screen displays the following information about the spillover average displayed.

Spillover Value Key

This refers to the location of the spillover data in the Spillover Values table of the Eclipse LB Microsoft Access database, Eclipse.mdb.

Is Current

Whenever an efficiency calibration procedure is run, Eclipse LB will store the spillover results of that efficiency count as *Current*. All previous spillover values from efficiency runs that are of the same type (count mode and geometry) and for the same device and detector will be stored as not current. You can clear any spillover value and recheck a previous spillover value to be used as current. Only one spillover value per standard, count mode, geometry, decay mode, device and detector combination can be current.

Use for QC

Not utilized by Eclipse LB at this time.

Batch ID

This entry field displays the name of the procedure used to generate this data plus the sample identification of the first sample of this batch.

Batch Key

This identifies the location of this batch in the Batch table of the Eclipse LB Microsoft Access database, Eclipse.mdb.

Standard ID

The Standard ID of the source used to generate this spillover value is listed in this entry field.

Standard Key

This identifies the location of this standard in the Standards table of the Eclipse LB Microsoft Access database, Eclipse.mdb.

Device Name

This is the name of the device used to measure this spillover value.

Detector Key

This identifies the location of this detector in the Detectors table of the Eclipse LB Microsoft Access database, Eclipse.mdb.

Count Mode

This is the Eclipse LB count mode (alpha only, alpha then beta or simultaneous) used to generate this spillover value.

Note: Eclipse LB will display a spillover record for every efficiency calibration procedure performed. Spillover is only calculated for efficiencies performed in the simultaneous count mode.

Decay Mode

This identifies the standard as an alpha or beta emitter.

Geometry

This is the geometry selected when performing this spillover measurement and calibration.

Model

This identifies the model used as a reference in the analysis of unknown samples. For standard efficiency calibrations this will be listed as "constant". For attenuation efficiency calibrations, the geometric model (Exponential, Linear, Inverse Linear or Inverse Quadratic) used to fit the data will be listed here. See "Attenuation Averages" on page 125.

Alpha → Beta

Spillover

This entry field displays the calculated spillover, in percent.

Uncertainty

This entry field displays the calculated uncertainty of the spillover value listed.

Record

This displays the number of the record displayed plus how many efficiency records are stored in the Eclipse LB database.

View Runs

Clicking on this button will display the Runs data associated with this Spillover Average (Figure 101). Displayed in this Runs table are: Acquisition Date, Geometry, Spillover %, Uncertainty %, Run Key, Sample Aliquot Key, and Use for QC.

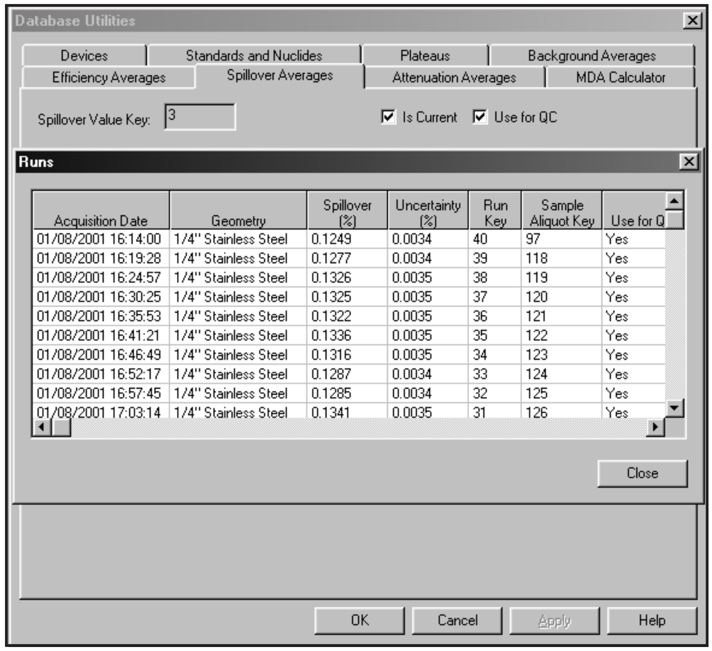


Figure 101 Displaying the Spillover Data

Use the navigation buttons to move through this table. Click **Close** when finished. Click **OK** to exit the Eclipse LB Database Utilities or another tab to continue.

Attenuation Averages

The Attenuation Averages tab will display the results of calibration efficiency runs performed on this system to determine the attenuation effect of sample residual mass. This screen is accessed by clicking **Edit Attenuation Averages** or the *Attenuation Averages* tab. If no attenuation efficiencies have been run, a message appears: “There were no records found in the Efficiency Values table”. Click **OK** to continue.

Once an attenuation efficiency procedure has been run on this system, the Attenuation Averages screen will appear as shown in Figure 102.

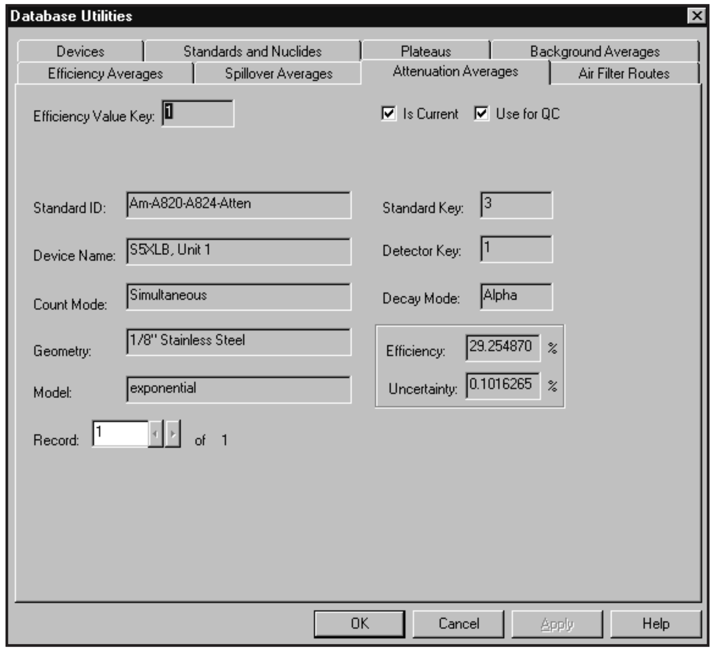


Figure 102 Attenuation Averages Screen

This screen displays the following information about the attenuation efficiency average displayed.

Efficiency Value Key

This refers to the location of the attenuation efficiency data in the Efficiency Values table of the Eclipse LB Microsoft Access database, Eclipse.mdb.

Is Current

Whenever an attenuation efficiency calibration procedure is run, Eclipse LB will store the results of that count as *Current*. All previous attenuation efficiency runs that are of the same type (count mode and geometry) and for the same device, detector and standard will be stored as not current. You can clear any attenuation efficiency and re-check a previous efficiency to be used as current. Only one attenuation efficiency value per standard, count mode, geometry, device and detector combination can be current.

Use for QC

Eclipse LB provides the you with a QC Chart program in order to verify the continuing performance of a system. This QC Chart program uses the results of efficiency and background counts to make this determination. All efficiency counts are checked for use with this QC program. If you do not want a specific efficiency count to be used for this test, this check box can be cleared.

Standard ID

The Standard ID of the attenuation source set used to generate this attenuation efficiency calibration value is listed in this entry field.

Standard Key

This identifies the location of this standard in the Standards table of the Eclipse LB Microsoft Access database, Eclipse.mdb.

Device Name

This is the name of the device used to generate this attenuation efficiency calibration value.

Detector Key

This identifies the location of this detector in the Detectors table of the Eclipse LB Microsoft Access database, Eclipse.mdb.

Count Mode

This is the Eclipse LB count mode (alpha only, alpha then beta or simultaneous) used to generate this attenuation efficiency value.

Decay Mode

This identifies the standard as an alpha or beta emitter.

Geometry

This is the geometry selected when performing this attenuation efficiency calibration.

Model

This identifies the model used to best fit the attenuation efficiency data accumulated for this calibration. Possible models are Exponential, Linear, Inverse Linear and Inverse Quadratic.

Efficiency

This entry field displays the result of this efficiency calibration, in percent, for the zero (0) mass, X-axis intercept.

Uncertainty

This entry field displays the calculated uncertainty of the efficiency value listed.

Record

This displays the number of the record displayed plus how many efficiency records are stored in the Eclipse LB database.

Once all attenuation selections have been made click **OK** to exit the Eclipse LB Database Utilities or another tab to continue.

MDA Calculator

The MDA Calculator screen allows you to calculate the Count Time required for a specified Minimum Detectable Activity or Minimum Detectable Activity (MDA) for a specified counting time, depending on which option is selected in the Calculate group box. This screen is accessed by clicking **MDA Calculator** or the *MDA Calculator* tab.

Calculate Count Time

In the Calculate group box select *Count Time*. The equation used to calculate the count time is shown in the upper right side (Figure 103).

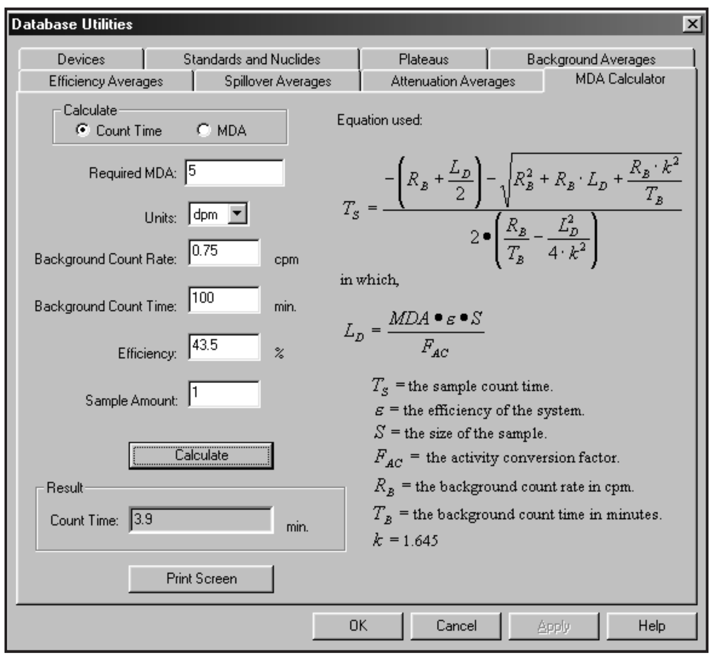


Figure 103 Calculating the Count Time

Required MDA

Enter the desired Minimum Detectable Activity (MDA).

Units

Enter the desired units of Required MDA entry. Units available are Bq (Bequerels), dpm (disintegrations per minute), pC (picocuries), or μCi (microcuries).

Background Count Rate

Enter the alpha or beta background count rate in cpm relative to the required MDA entry.

Background Count Time

Enter the background count time used to determine the background count rate.

Efficiency

Enter the alpha or beta efficiency of the system in percent relative required MDA entry.

Sample Amount

Enter the amount of the sample in the desired MDA units.

Calculate

Clicking on this button will calculate the count time in minutes required to reach the Required MDA entry. The count time is displayed under Results.

Print Screen

Prints the screen.

Calculate MDA

In the Calculate group box select *Minimum Detectable Activity (MDA)*. The equation used to calculate the MDA is shown in the upper right side (Figure 104).

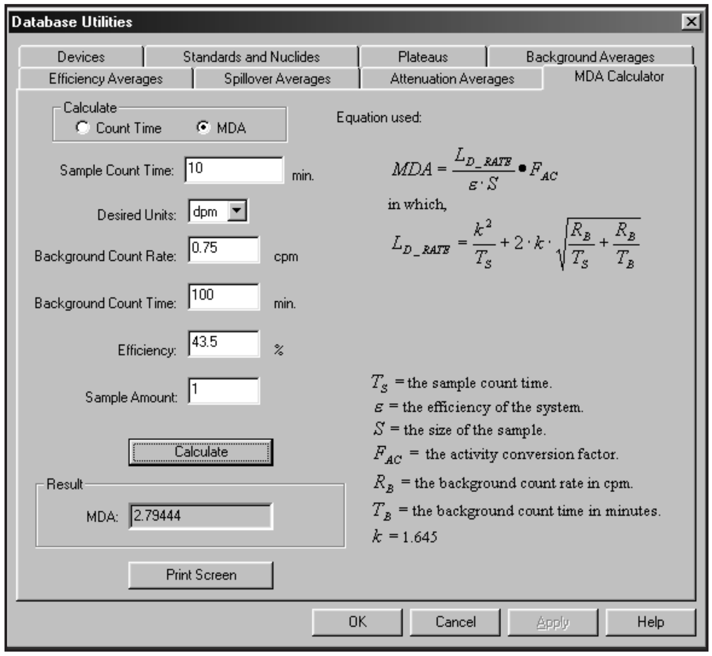


Figure 104 Calculating the Minimum Detectable Activity (MDA)

Sample Count Time

The sample count time in minutes. The count time must be between 0.2 and 9999 minutes

Desired Units

Enter the desired MDA units. Units available are Bq (Bequerels), dpm (disintegrations per minute), pC (picocuries), or µCi (microcuries).

Background Count Rate

Enter the alpha or beta background count rate in cpm relative to the required MDA entry.

Background Count Time

Enter the background count time used to determine the background count rate.

Efficiency

Enter the alpha or beta efficiency of the system in percent relative required MDA entry.

Sample Amount

Enter the amount of the sample in the desired MDA units.

Calculate

Clicking on this button will calculate the MDA. The MDA is displayed under Results.

Print Screen

Prints the screen.

8. Sample Manager

Eclipse LB provides you with a convenient method to enter sample information needed for the analysis of that sample. This information can be for one specific batch of samples or for batches of samples that are routinely counted.

Opening the Sample Manager

The Sample Manager can be used for previously counted batches of samples or uncounted batches of sample. The Eclipse LB Sample Manager can be initiated using either of two methods. From the Manage menu, choose **Samples** or from the toolbar select the **Sample Manager** button (blue and red Marinelli beakers).

Previously Counted Batches of Samples

For batches of samples that have already been counted, right-click on the row of any sample in the *Samples* tab page to open the Eclipse LB Sample Manager. This will display the non-template Sample Manager screen (Figure 105).

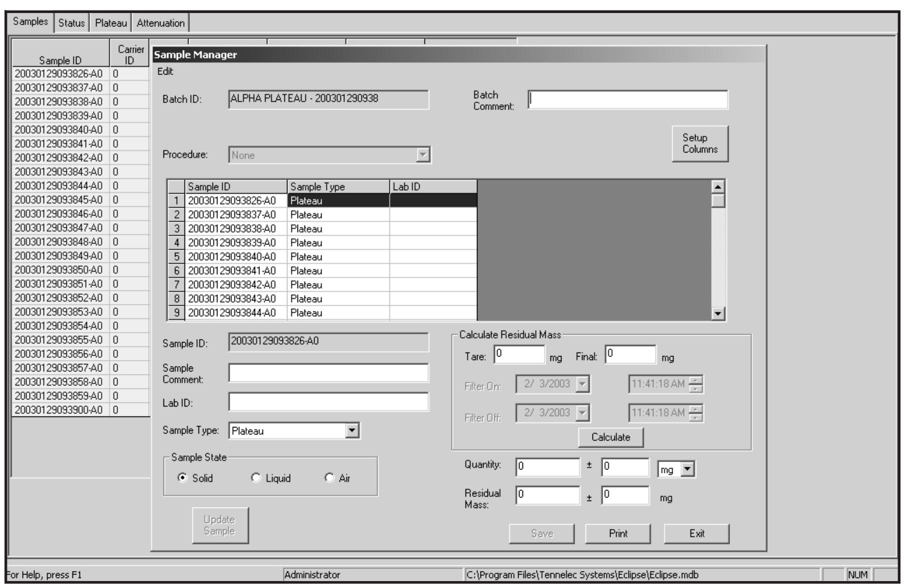


Figure 105 Sample Manager - Sample Screen

Note that the *Batch ID* listed is the name of the Eclipse LB sample analysis procedure used to generate this data plus the date and time stamp associated with this batch of samples.

Highlight a sample in the Sample Manager table and enter the appropriate information into the entry fields provided. When all of the data is entered for this sample, click on the **Update** button to store this information into the Eclipse LB Sample Manager table. When all of the information has been entered and stored for all of the samples, click on **Save**. This saves all of the Sample Manager information for this previously counted batch of samples into the appropriate Eclipse database tables. If no corrections are required, click on **Exit** to leave the Eclipse LB Sample Manager. Exiting the Eclipse LB Sample Manager also initiates the update of the sample data shown on the Samples tab page.

Uncounted Batches of Samples

Eclipse LB provides you with a convenient method to pre-enter sample information for a specific batch of samples that have not yet been counted or, as a template, for batches of samples that are routinely counted. From the **Manage** menu, choose **Samples** or from the toolbar select the **Sample Manager** button (blue and red Marinelli beaker) to access to the Eclipse LB Sample Manager.

The initial Sample Manager screen (Figure 106) provides you with the ability to either **Show template batches only** or **Show batches (uncounted)**. If no templates have been created and no uncounted batches exist, the only option available is *New*.

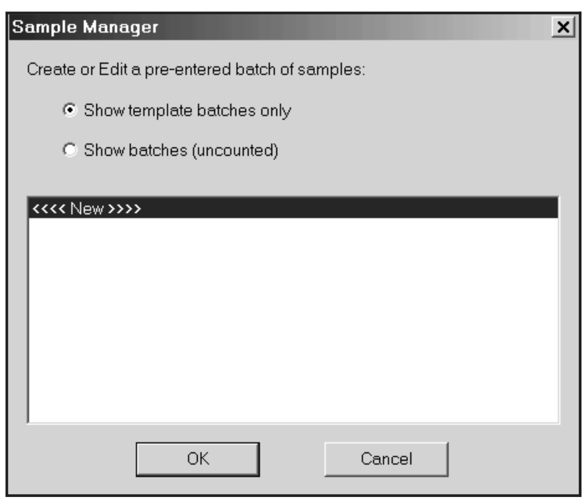


Figure 106 Initial Sample Manager Screen

Creating a Batch for Non-Repetitive Samples

Creating a batch of information for samples that have not yet been counted is quite similar to the method used for previously counted batches of samples. For example, you can create a non-template batch for the analysis of 20 smear samples that all have the same laboratory ID except for the last three numerical values. The following steps must be performed:

1. The first step in this process is to open the Eclipse LB Sample Manager by clicking on the **Sample Manager** button.

2. Select **Show batches (uncounted)** and *New*. Click on the **OK** button.

3. Enter a *Batch ID*, *Lab ID*, *Sample Type*, and *Sample State* for the first sample and click on the **Update Sample** button to enter this information into the Sample Manager table (Figure 107).

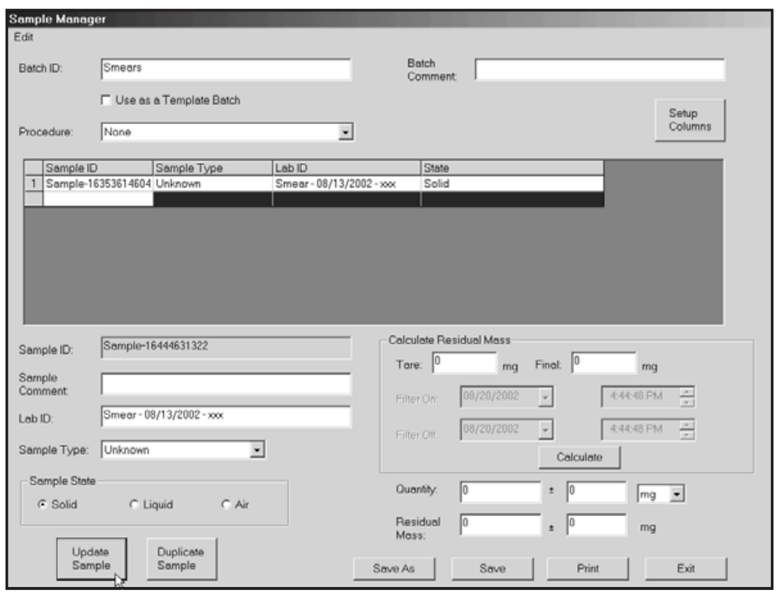


Figure 107 First Sample Entered

4. Highlight this sample in the Sample Manager table and from the **Edit** menu, choose **Copy**.

5. Using the mouse or down arrow, highlight the next row down in the Sample Manager table.

6 From the **Edit** menu, choose **Paste Special** (Figure 108). In the dialog box enter 19 as the number of samples to create. Click **OK**. The Sample Manager table is now updated with 20 samples. To remove a sample, highlight the sample and from the **Edit** menu choose **Delete**.

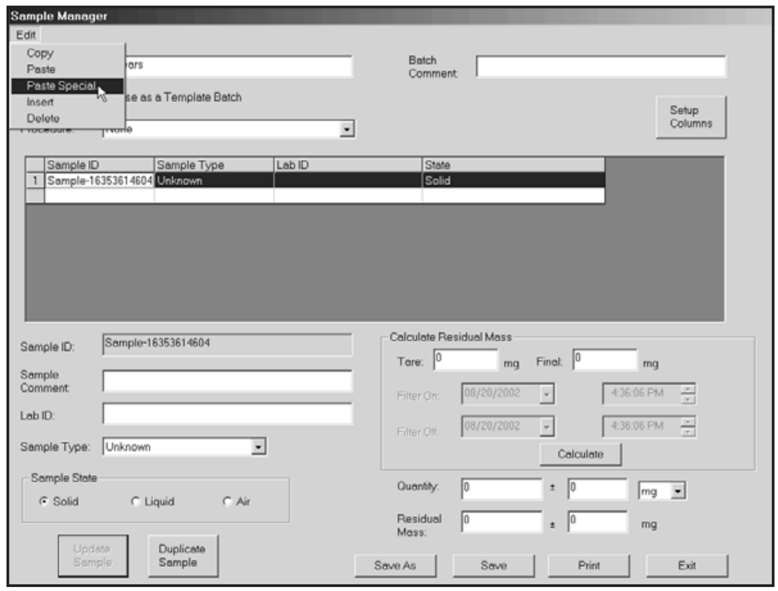


Figure 108 Adding a Sample

7. You can highlight each sample in the table, change the last three digits of the *Lab ID* to the correct value and update each sample individually. Once all of these changes have been made and updated in the table, they must be saved to the Eclipse LB database tables by clicking on the **Save** button.

This batch is now ready for use in the analysis of 20 smear samples.

Creating a Batch Template

To create a batch template, open the Eclipse LB Sample Manager from the **Manage** menu or the **Sample Manager** button. Leave **Show template batches only** selected, the *New* selection highlighted and click on the **OK** button (Figure 109).

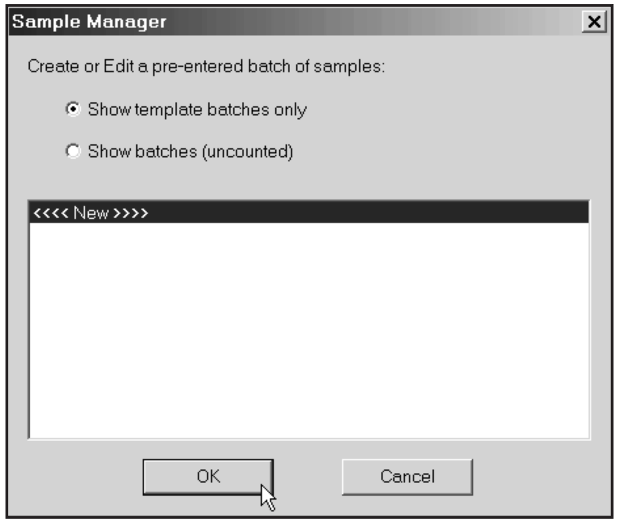


Figure 109 Creating a Sample Batch Template

A Sample Manager template is a model that can be used repetitively to enter data that is specific to the unknown samples to be analyzed (Figure 110). The following options are provided for the creation of a batch template. You can add duplicate samples to the batch template as explained in “Adding Duplicate Samples” on page 138.

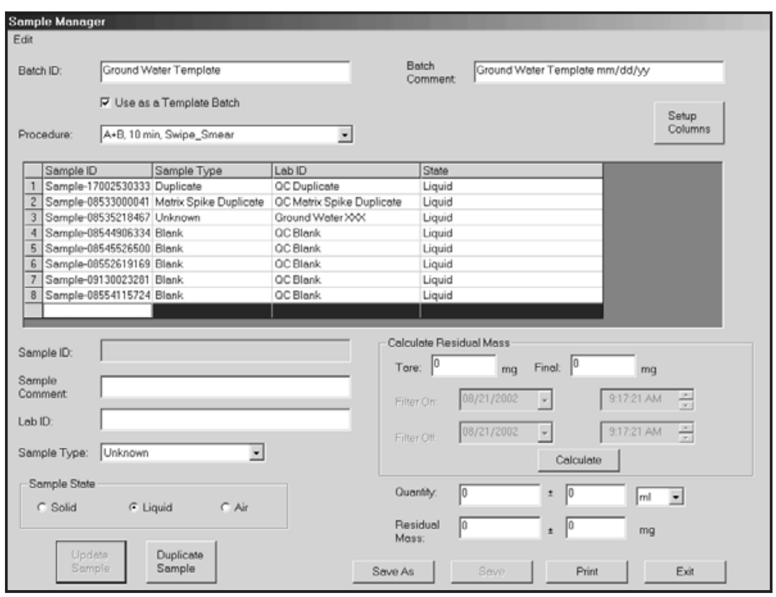


Figure 110 Sample Manager Screen with Samples Entered

Batch ID

This entry field is provided for the name of the template. In this example, Ground Water Template is the name chosen. The "Use as a Template Batch" check box is selected as this template will be repetitively used to input data specific to ground water samples to be analyzed.

Batch Comment

This entry field is provided for comments appropriate to the batch of samples analyzed. "mm/dd/yyyy " has been added to the Batch ID to indicate that the date of analysis should be entered in this entry field when actual samples are to be analyzed. This comment is displayed in the Recall Batch dialog box.

Procedure

List of all active procedures. A procedure *must* be selected or the template batch will not be available in the Start a Count dialog box for use for batch sample analysis.

Setup Columns

This pushbutton allows you to configure the gird display by selecting options from the Column Setup dialog box.

Sample ID

This entry field is filled by Eclipse LB and is not available for user input. Eclipse will enter the word "Sample" followed by the time of day that this sample information was updated.

Sample Comment

This entry field is provided for comments appropriate to the sample being analyzed.

Lab ID

This entry field is provided for a laboratory identification that is specific to the sample to be analyzed.

Sample Type

Select from the following list for this entry field.

Unknown	LCS	Matrix Spike Duplicate
Blank	Duplicate	Plateau
Background	Matrix Spike	Calibration Standard

Sample State

Select Solid, Liquid, or Air Flow as the original state of the sample(s) to be analyzed.

Calculate Residual Mass

If a solid or liquid sample type was selected, the Calculate Residual Mass group box allows you to enter the Tare and Final weights of the sample. Once entered click on the **Calculate** button the residual mass of the sample will be determined by subtracting the Tare weight from the Final weight.

Calculate Flow

If an air sample type was selected, the Calculate Flow group box allows you to enter the Start and End flow rate of the sample and the Filter On and Filter Off dates and times. Once entered click on the **Calculate** button to calculate the total volume of or that passed through sample.

Quantity

This is the quantity of the original sample. If a 10-ml volume sample of ground water is to be processed for analysis, and the results reported in activity per liter, then a value of 0.01 should be entered into the first space. A value based on the error of that volume should be entered into the second space and "l" selected for the units. You can choose cf. (cubic feet), l (liters) or ml (milliliter's) for the sample Quantity value.

Residual Mass

This is the weight of the actual sample to be analyzed. This information is important if the analysis results are to be attenuation corrected.

Update Sample

Click on this button to enter information into the Sample Manager table

Duplicate Sample

This button will allow you to create one copy of a highlight sample at the end of a batch.

Once the values for the first sample, the blank in this example, have been entered, the operator should click on the **Update** button to register this information in the table shown at the top of the page. The information for the second sample can then be entered. Again, click on the Update button and continue with this process until all of the samples for this template have been registered into the table.

Adding Duplicate Samples

When a batch of samples to be analyzed contains multiple samples of nearly identical characteristics, Eclipse LB provides you with a quick and convenient method of adding these duplicate samples to the batch template. In this example, seven unknown samples will be analyzed. Once the information for the first unknown sample has been entered, you must click on the **Update** button to register this information into the Sample Manager table. The next row down will become highlighted for entry of information for the next sample.

Using the mouse or up arrow, highlight the previously entered unknown sample. Once this is done, from the **Edit** menu, choose **Copy**.

Using the mouse or down arrow, highlight the horizontal row below the last sample listed in the Sample Manager table. From the **Edit** menu, choose **Paste Special** and then enter the number in the dialog box. Six duplicate samples will be added to the bottom of the table.

You can add a new sample to the table by highlighting the sample and selecting **Edit** menu, then **Insert**.

When all samples have been added to the Sample Manager Batch Template table, click on the **Save** button to store this information into the appropriate Eclipse LB database tables. Once saved, this template can be used for the analysis of batches of samples or modified, more samples added, etc. and then saved under a new name using the **Save As** button. You can **Exit** to the Eclipse LB main screen or edit this template to create a new Template Batch.

If the **Exit** button is clicked on before the batch is saved, Eclipse LB Sample Manager displays a message allowing you to return to the Sample Manager screen and save any changes made before exiting (Figure 111).

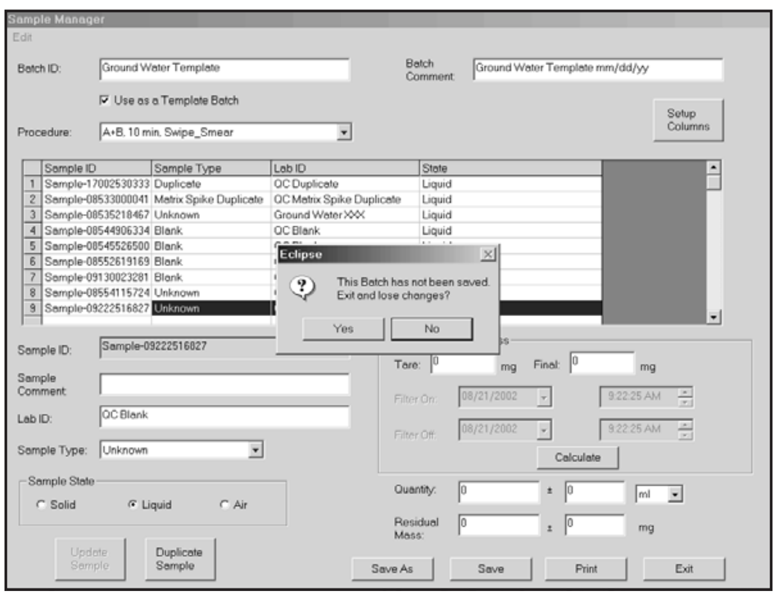


Figure 111 Exiting Sample Manager Screen without Saving Changes

Editing a Sample Manager Template Batch

Open the Eclipse LB Sample Manager, select the Template Batch to edit and click **OK** (Figure 112).

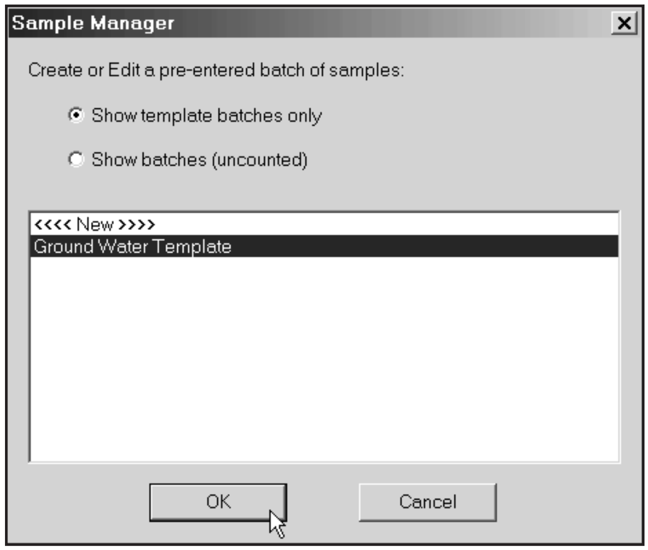


Figure 112 Editing a Batch Template

The previously created template, "Ground Water Template" can be edited to include corrected, actual sample information, or to add more samples, etc. Once all edited or added samples have been updated, click **Update**. The template can be saved under the same original name, by clicking **Save**, or under a new different name, by clicking **Save As**. Enter the new name in the Batch ID box and click **OK** to save this template under this new name (Figure 113).

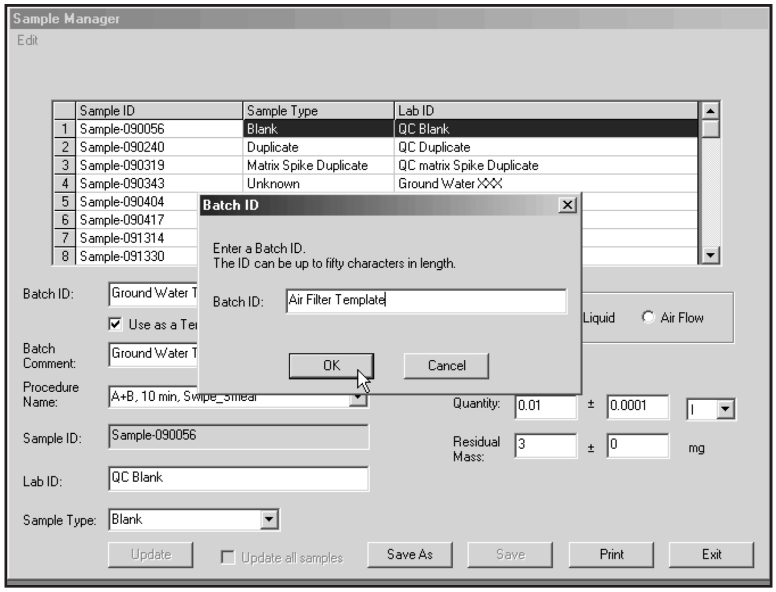


Figure 113 Entering a New Batch Name

Once this is completed, the Batch ID will be changed to the new name. You can **Exit** the Sample Manage or print the batch template.

Printing a Sample Manager Batch

Template batch data can be printed or previewed by clicking on the **Print** button. You can then select to **Print** or **Print Preview** the Template Batch report (Figure 114).

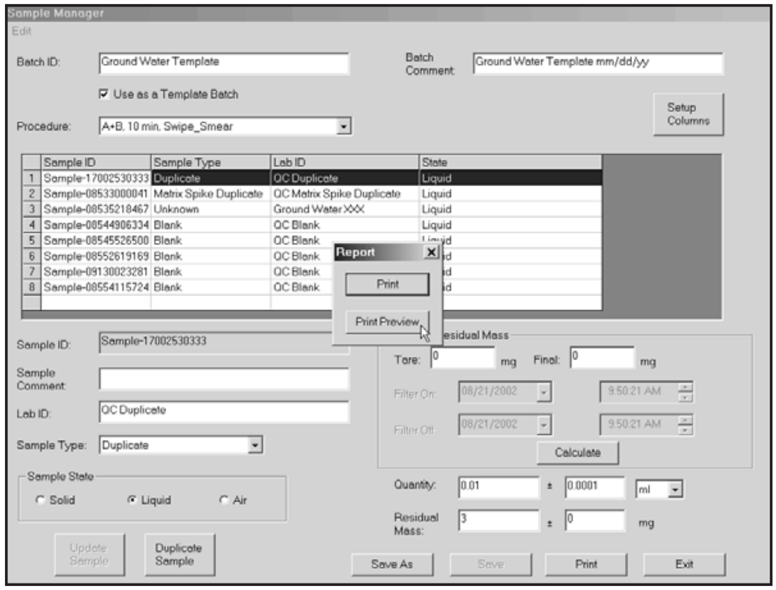


Figure 114 Printing or Previewing Batch Data

If **Print Preview** is selected, the Batch Template report will be displayed on the computer screen and can then be printed by clicking on the print button (Figure 115).

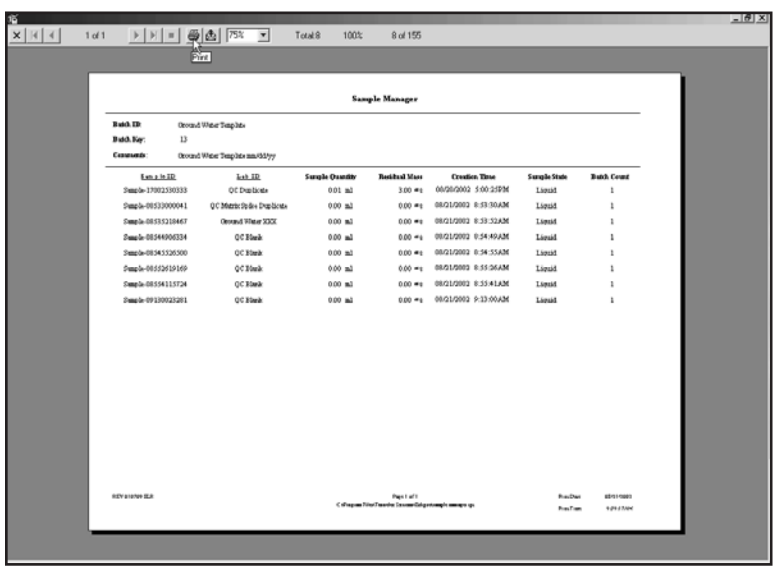


Figure 115 Viewing a Batch Template Report

Analyzing Sample Manager Batch Samples

Once a Sample Manager batch has been created for the analysis of specific samples, it can be selected when those samples are analyzed.

You should first load all of the samples to be analyzed in the “send”, right side, stack of the Tennelec automatic low background system. Note: It is very important that the samples being analyzed are inserted into the Tennelec system in the exact same order as they are listed in the Sample Manager batch. A batch template printed report is beneficial for this.

Begin a counting procedure by clicking on **Count | Go** or the **Go** button. The **Start a Count** dialog box (Figure 116) appears. Uncounted batches and batch templates will appear at the top of the list, identified by the red and blue Marinelli beaker icon. Highlight the batch to be counted, select the device and group then click **OK** to start the analysis.

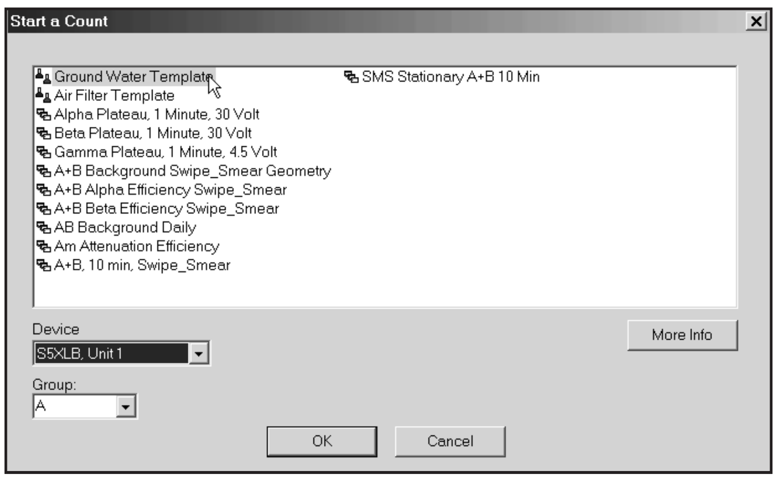


Figure 116 Selecting Batch Samples for Counting

Caution The previous version of Eclipse did not support attaching a counting procedure to a pre-entered batch. When upgrading from a previous version and migrating the database using the DbConvert program all pre-entered batches saved under the previous version will not appear in list box until they are saved again with a counting procedure.

> The ability to attach a procedure to a pre-entered batch at run-time will no longer be allowed, as was capable in the previous version. All pre-entered batches must be defined with a counting procedure.

Clicking on the **More Info** button displays the Eclipse LB Sample Manager screen for the selected batch template. Exit returns you to the Start a Count dialog box.

Once this batch of samples has been counted, you can double-click on any sample on the Samples tab screen and view the information attached to this batch of samples using the Eclipse LB Sample Manager or click on the Status tab to view a summary of the procedure selected with the batch template.

9. Eclipse QC Chart Program

Eclipse LB provides you with a convenient method to track and evaluate the efficiency and background performance of your Tennelec system. It is recommended that you use the same efficiency and background procedures created and used for system calibration for system QC. To do this, select the “Use for QC Only” check box of the selected procedure. See Chapter 5, *Creating System Counting Procedures*, for more details. These procedures allow you to track the efficiency and background performance of your system without changing the calibration values used in the analysis of samples.

Opening the QC Chart Program

The QC Chart and Profile Program can be initiated using either of two methods. From the **QC** menu, choose **Edit/Create Profiles** or **Create Charts**, or from the toolbar select the **QC** button.

Creating a QC Profile

QC profile must first be created. From the initial QC Chart screen (Figure 117) select **Create/Edit a QC Profile** then click **OK**.

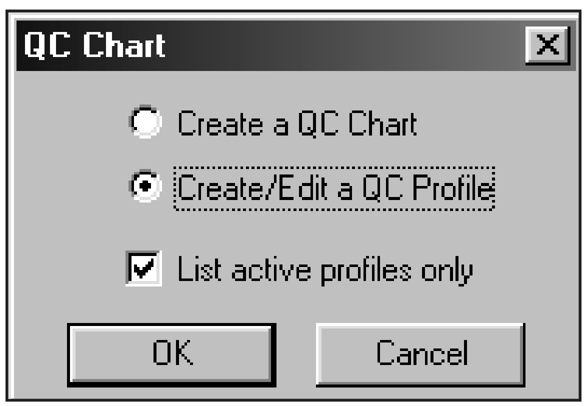


Figure 117 QC Chart Dialog Box

The QC Profile screen (Figure 118) appears allowing you to establish all of the parameters and conditions that will be used to generate a QC Chart for the evaluation of your system performance. If no profiles have been previously created, you must click on **New** and enter the name of your profile.

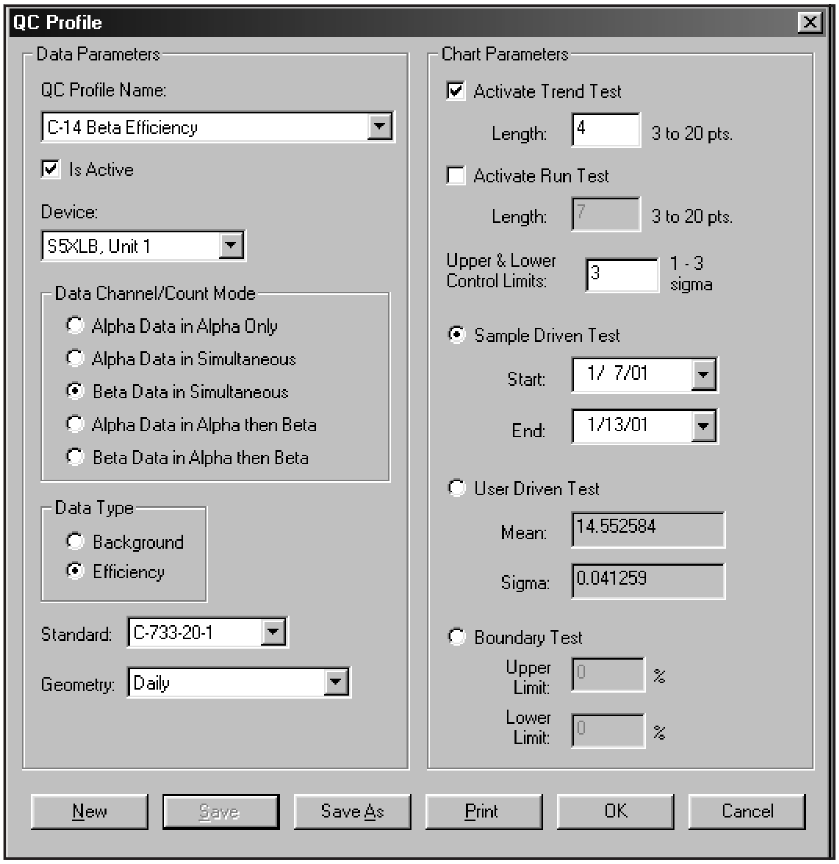


Figure 118 QC Profile Screen

The following options are available for the creation of a QC profile. If any of these options/values are changed, the profile must be saved once again.

Data Parameters

Device

If you have more than one device, Tennelec Alpha / Beta System, under the control of this computer, you must select which device you are evaluating. A drop down list is provided for all systems registered. See “Devices” on page 107.

Data Channel/Count Mode

Five choices are provided for either alpha or beta data using either the alpha only, simultaneous or alpha then beta counting mode.

Data Type

Background or Efficiency performance may be selected for tracking.

Standard

If Efficiency is chosen, the source that will be used for these tests must be selected. Ideally, this should be the same source used for system calibration

Geometry

From the *Geometry* list choose: 1/8” Stainless Steel, ¼” Stainless Steel, 5/16” Stainless Steel, Daily, or Swipe/Smear. You can track you system performance for multiple geometries by creating profiles for each geometry.

Chart Parameters

Activate Trend Test

A Trend is a specified number of data points that are either continuously increasing or decreasing. This might, for example, be a continuously decreasing efficiency or continuously increasing background. The Eclipse QC Chart program allows you to identify the number of points that you define as a trend. If the system QC data acquired includes the number of data points you have defined in an increasing or decreasing trend, these data points will be identified on the QC chart with red “X”s.

Figure 119 shows a 4-point trend in C-14 beta efficiency data. (The default number for a trend is 7 points) The data displayed on this chart has been edited to show this and other Eclipse QC Chart examples.

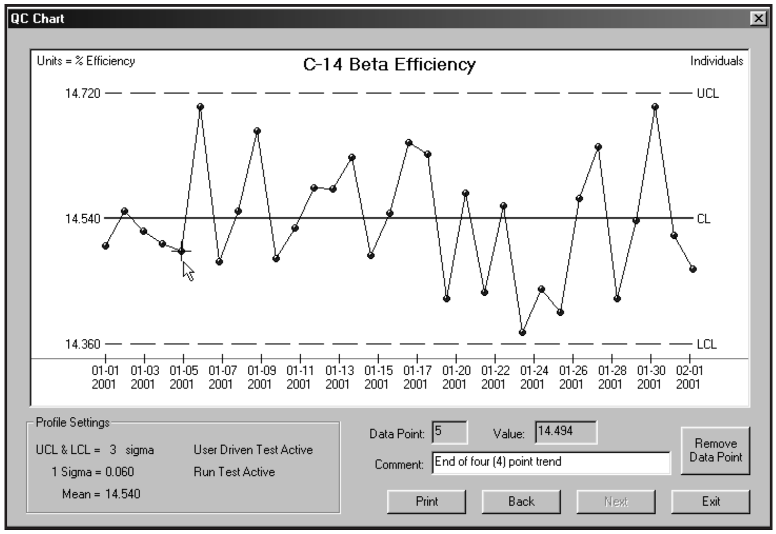


Figure 119 C-14 Beta Efficiency Chart with a Four Point Trend

Activate Run Test

A run is a series of data points that are consistently above or below the mean value. Under normal operating conditions, efficiency QC values and background QC values will vary above and below the mean efficiency or background value. If, for example, the efficiency data points are consistently below the mean or if the background is consistently above the mean, the system may have a problem. The efficiency standard may have been placed in a deeper insert than normal, resulting in a lower efficiency or the detector window may have become contaminated, resulting in a higher than normal background. Whatever the cause, a “run” indicates that something is different about the system and should be investigated.

Figure 120 shows a run of seven C-14 efficiency data points above a mean efficiency value of 14.5%. This mean efficiency value was created using the Boundary Test described on page 150.

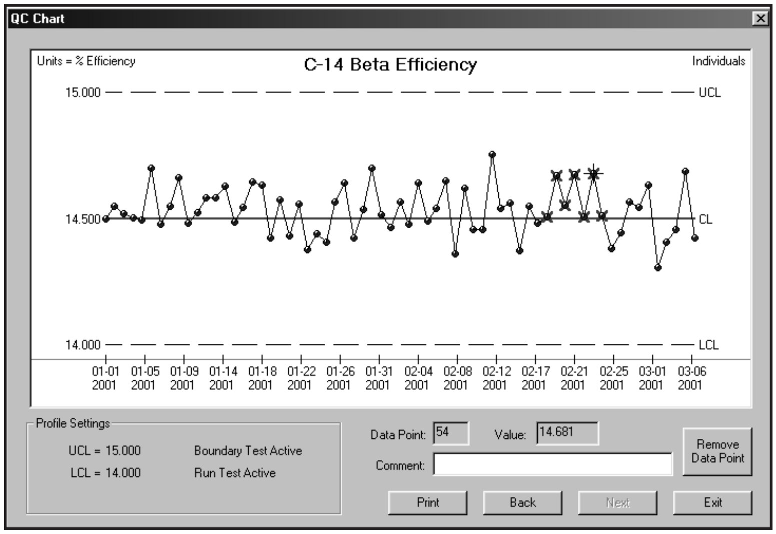


Figure 120 Seven Data Points Above the Mean Efficiency Value

Upper & Lower Control Limits

Selectable from 1 to 3 sigma. If a data point is above or below these limits, that data point will be identified by placing a red “X” over the data point. Examples of this are shown in Figure 119 for the data points at 01-06-2001 and 01-30-2001. Other points are also marked on this chart. As before, the data displayed on this chart has been edited to show this and other Eclipse QC Chart examples.

Sample Driven Test

If this option is selected, Eclipse LB will use the data from the time period selected, Start and End dates, and determine the mean and sigma for the type of performance being evaluated. Once the End date is selected, these calculated values will be inserted in the appropriate boxes beside and below User Driven Test. If invalid dates are selected, no data available, Eclipse LB will indicate this with an error message and ask you to enter data in the User Driven Test section. You may also select new, valid dates.

User Driven Test

This option allows you to enter your own Mean and Sigma values for the chart presentation of the data being evaluated. If Sample Driven Test was originally selected with valid dates, values will be entered in both the Mean and Sigma fields. These values can be accepted or changed.

Boundary Test

If you prefer to set your own upper and lower limits for the QC chart, select this option. If efficiency performance is being charted, enter efficiency values in % that are above and below the average efficiency you expect. If background performance is being charted, then you should enter upper and lower values in counts per minute (cpm) that are above and below the background value you expect. Eclipse LB will calculate the mean as the average value of your entries. For example, if you enter 16% as the upper efficiency limit and 14% as the lower limit, Eclipse LB will use 15% as the mean efficiency value for the chart.

Once you have made all of your selections for the QC Profile selected, click on **Save** to save the QC profile created. You can click **Print** to print the QC profile screen or **OK** to exit.

Create a QC Chart

After a QC Profile has been created a QC chart can now be generated. From the initial QC Chart screen (Figure 121) select **Create a QC Chart** then click **OK**.

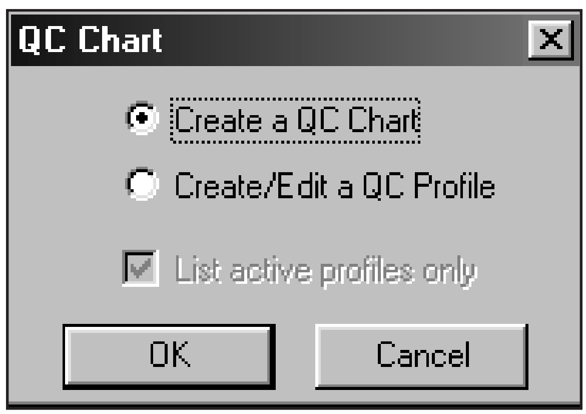


Figure 121 QC Chart Dialog Box

The Create a QC Chart screen (Figure 122) appears allowing you to select the chart(s) to create and their display options.

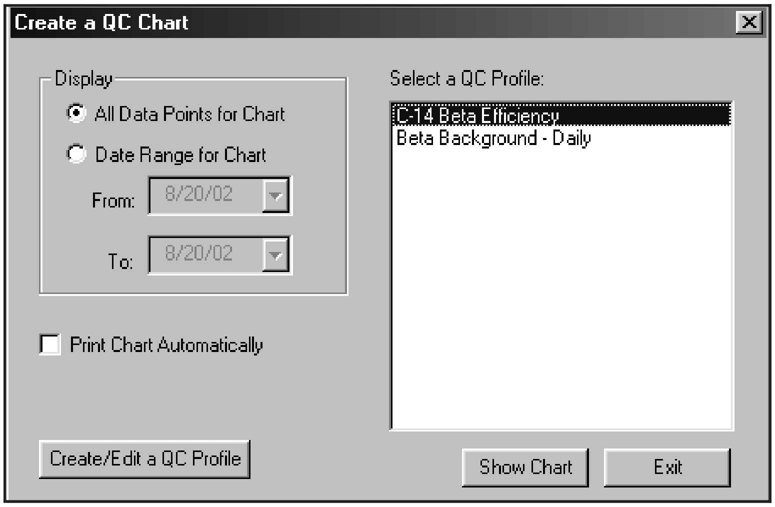


Figure 122 Creating a QC Chart

Select a QC Profile

All of the QC profiles you have created are listed on the right side of this page. Using your mouse, you may select any one or all profiles to display. If more than one profile is highlighted for display, Eclipse LB will allow you to step through each profile in the order they are listed by clicking on the **Next** button on the QC Chart Screen (Figure 123).

Display

Two options are available. You can select “All Data Points for Chart” to display every QC data point in the database that meets the criteria of the QC Profile or select “Date Range for Chart” and display only those data points that fall within the From: and To: dates.

Print Chart Automatically

Select this option to automatically print the QC chart.

Show Chart

Once you have defined the data points for the chart and the QC profile to use, click on the **Show Chart** button to display the QC chart.

Create/Edit QC Profile

Click on this button to display the QC Profile screen for the selected QC profile.

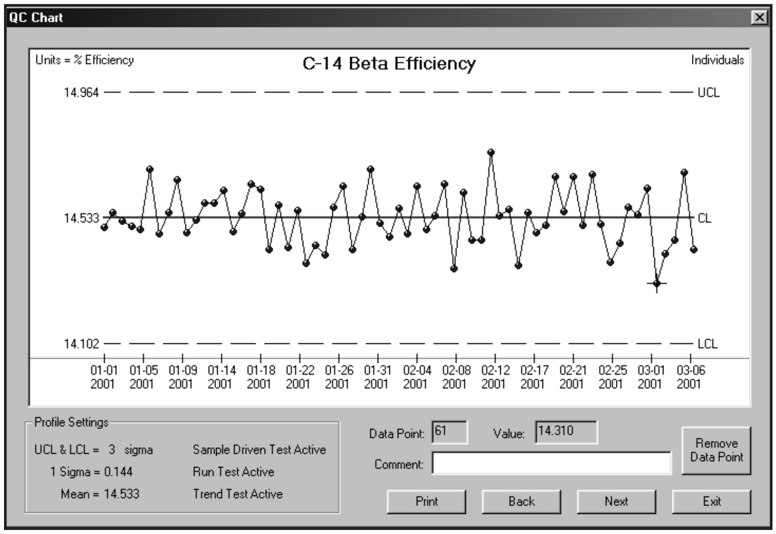


Figure 123 C-14 Beta Efficiency Chart

The QC Profile Settings used to generate this chart are listed in the bottom left corner of the display. This chart contains 66 data point. You can click on any data point on the chart and data point number and efficiency value associated with that data point is displayed at the bottom of the screen. On the occasion where the wrong standard was used to measure this efficiency performance, a data point might show up clearly above or below the chart control limits. You can click on that data point and then on the **Remove Data Point** button to remove that data point from the chart. You may also type in a Comment such as “Wrong standard” and Eclipse LB will attach that comment to that data point, leaving it on the chart. Removed data points are only removed from the chart. Data is not removed from the Eclipse LB database.

The Upper Control Limit and Lower Control Limit are identified with dashed lines with values displayed on the left of these lines. The Mean Value of the displayed data is identified with a solid line. The month, day and year of the data points plotted are displayed below the x-axis of the chart.

If more than one QC Profile was selected for display, you may click on the **Next** button to display the next chart. This is a very convenient feature for the sequential display of your daily alpha efficiency, beta efficiency and background.

Clicking on the **Print** button brings up a dialog box allowing you to Print the Chart, Print a Report, or Preview the Report. Click **OK** to generate the Chart and or Report you have selected. Clicking on the **Back** button returns you to the Create a QC Chart screen and Exit to return to the Eclipse Main Screen.

You can right click within the chart area to access chart features such as Y Axis: Label Limits, Print the chart, Mark a data point, Copy the chart, Replot the chart or change the Colors of text (Figure 124).

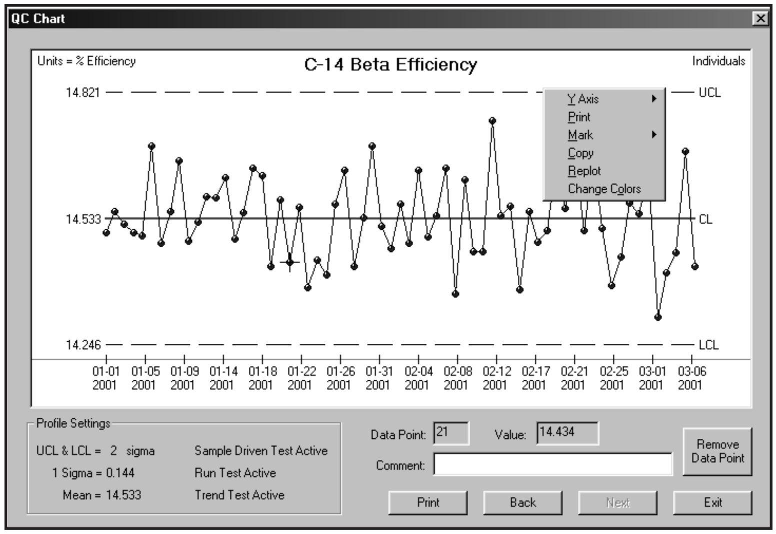


Figure 124 QC Chart Options

10. Sequence Manager

Eclipse LB provides you with a convenient method to define a series of procedures to run in a specified order. The Eclipse LB Sequence Manager can be initiated using either of two methods. From the **Manage** menu, choose **Sequences** or from the toolbar select the **Sequence Manager (SM)** button. The initial Sequence Manager screen (Figure 125) appears allowing you to select and create, or edit, a counting sequence. There are three types of counting sequences that can be defined. They are: AutoCal Sequence, AutoQC Sequence, and Super Sequence.

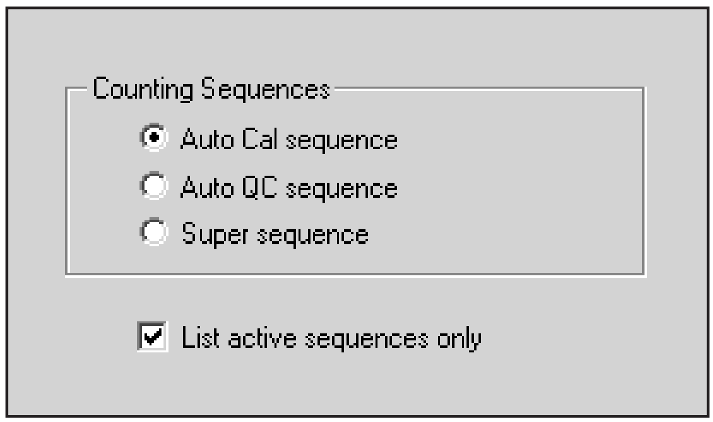


Figure 125 Initial Sequence Manager Screen

Select the "List active sequences only" check box to view all or only the active sequences. The default is to list all active sequences.

Calibration Sequence (AutoCal)

AutoCal sequences are used to change the overall system calibration. A calibration counting sequence is created by starting the Sequence Manager, clicking on *Auto Cal Sequence* then **Next**. The Sequence Manager: AutoCal screen is displayed.

To create an AutoCal sequence for the complete, calibration or re-calibration of your Tennelec system, the following conditions apply:

1. If you intended to count unknown samples using an alpha only or alpha then beta count mode, an alpha plateau as well as a beta plateau procedure must be included in the AutoCal sequence.

2. Any Plateau procedure included in a sequence must come before any non-plateau procedure in the sequence.

3. If an Auto ROI procedure is included in the sequence, it must come after all plateau procedures and before all other procedures. See for details on how to create an Auto ROI procedure see page 165.

4. The operating voltage determined by a plateau procedure run in the sequence becomes the current system operating voltage immediately upon completion of that plateau procedure. Any procedure executed after that plateau procedure, whether in the same sequence or not, uses the new voltage setting.

5. The discriminator settings determined by an auto ROI procedure are applied to all the remaining procedures in that sequence that use the status of the ROI procedure executed. Before any procedure using the new settings completes, the *Status* tab Discriminator Settings will display a –1 value for the Alpha Lower Level, Beta Lower Level, and Beta Upper Level settings. Once the batch completes the ROI values used will be displayed and the procedure definition modified to the new ROI settings.

If no auto calibration sequences have been previously created, click **New** and enter an appropriate sequence name (Figure 126).

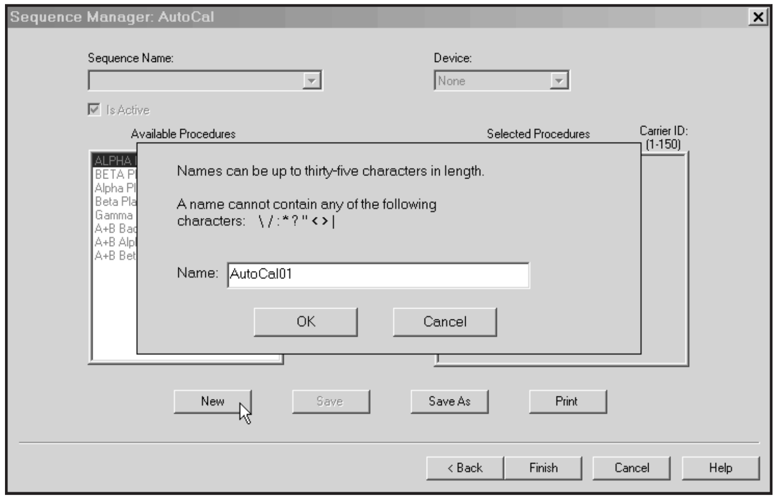


Figure 126 Naming an Auto Cal Sequence

The *Sequence Name* can be up to 35 characters long. The symbols, \ / : * ? “ < > and | can not be used. The sequence name should be sufficiently descriptive that you will clearly understand the data acquisition and analysis details of this sequence, when choosing it for execution.

After clicking **OK**, the sequence name will then appear in the *Sequence Name* list. Eclipse LB will automatically save this sequence as “active” (Figure 127).

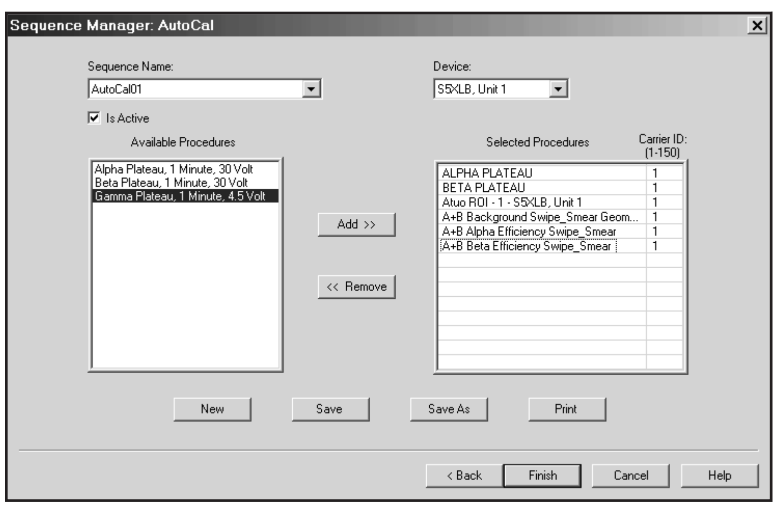


Figure 127 Auto Cal Sequence Screen

The following options are available for the creation of a automatic calibration sequence. If any of these options/values are changed, the procedure must be saved once again.

Is Active

Selecting the Is Active check box will change an active status to inactive and an inactive status to active. The default for Auto Cal sequence is Active. Inactive sequences are not available for use.

Device

Any registered counting system; default is *None*.

This selection will override any predefined devices within the individual procedures making up this sequence. Note: this option requires firmware version 3.0 or higher.

Available Procedures

This is a list of all active calibration procedures: Plateau, Background, and Efficiency plus all Auto ROI procedures. When defining an AutoCal sequence all Background and Efficiency procedures previously counted are available for use. A vertical scroll bar will appear, if necessary, to allow viewing of all procedures in the list box.

Selected Procedures

This is a list of all calibration procedures that currently define this AutoCal sequence. A vertical scroll bar will appear, if necessary, to allow viewing of all selected procedures.

Within this list box you must define the ID number of the sample carrier containing the standard or Background media for the selected procedure. The carrier plate IDs do not have to be unique.

Note: The selected procedures will execute in the order displayed in the Selected Procedures list box.

Add Button

The **Add** button is used to add the procedure selected in the Available Procedures list box and to add it to the Selected Procedures list box.

Remove Button

The **Remove** button is used to remove the procedure selected in the Selected Procedures list box to the Available Procedures list box. This selection will then be added back into the Available Procedures list box.

Once all of the selections have been made, click **Save** to save this calibration counting sequence or save it under another name using the **Save As** button. This process may be repeated to prepare all of the calibration sequences needed. Once this is done, click **Finish** to exit Sequence Manager or **Back** to return to the initial Sequence Manager screen.

QC Sequence (AutoQC)

AutoQC sequences are used to measure system performance for quality control checks. A QC counting sequence is created by starting the Sequence Manager , clicking on *Auto QC Sequence* then **Next**. This displays the Sequence Manager: AutoQC screen.

If no auto QC sequences have been previously created, click **New** and enter an appropriate sequence name (Figure 128).

The *Sequence Name* can be up to 35 characters long. The symbols, \ / : * ? “ < > and | can not be used. The sequence name should be sufficiently descriptive that you will clearly understand the data acquisition and analysis details of this sequence, when choosing it for execution.

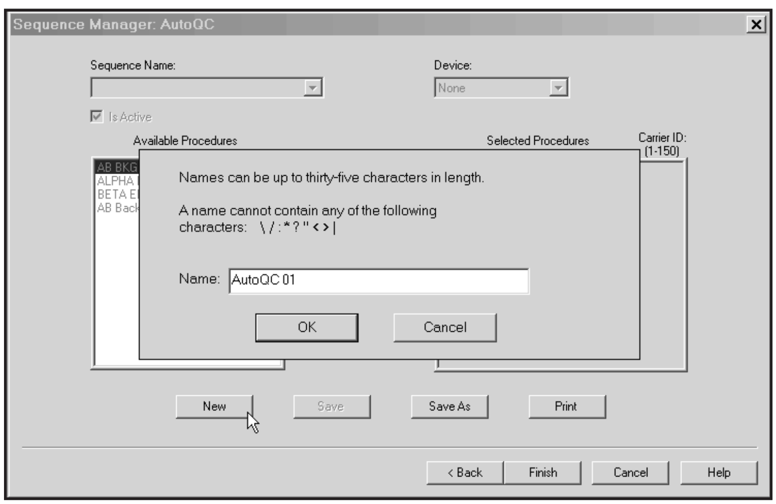


Figure 128 Naming an Auto QC Sequence

After clicking **OK**, the sequence name will then appear in the *Sequence Name* list. Eclipse LB will automatically save this sequence as “active” (Figure 129).

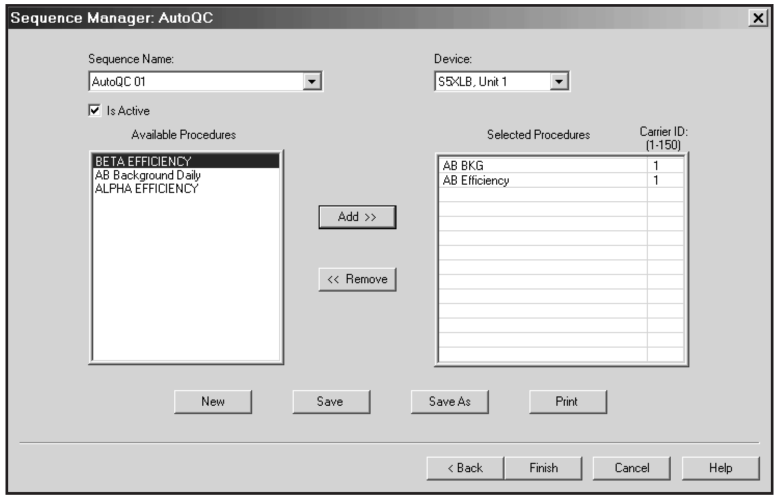


Figure 129 Auto QC Sequence Screen

The following options are available for the creation of an automatic QC counting sequence. If any of these options/values are changed, the procedure must be saved once again.

Is Active

Selecting the Is Active check box will change an active status to inactive and an inactive status to active. The default for Auto QC sequence is Active. Inactive sequences are not available for use.

Device

Any registered counting system; default is *None*.

This selection will override any predefined devices within the individual procedures making up this sequence. Note: this option requires firmware version 3.0 or higher.

Available Procedures

This is a list of all active Background and Efficiency procedures that have the “Use for QC Only” box selected in their procedure definition. A vertical scroll bar will appear, if necessary, to allow viewing of all procedures in the list box.

Selected Procedures

This is a list of all procedures that currently define this AutoQC sequence. A vertical scroll bar will appear, if necessary, to allow viewing of all selected procedures.

Within this list box you must define the ID number of the sample carrier containing the standard or Background media for the selected procedure. The carrier plate IDs do not have to be unique.

Note: The selected procedures will execute in the order displayed in the Selected Procedures list box.

Add Button

The **Add** button is used to add the procedure selected in the Available Procedures list box to the Selected Procedures list box. This selection will then be removed from the Available Procedures list box.

Remove Button

The **Remove** button is used to remove the procedure selected in the Selected Procedures list box to the Available Procedures list box. This selection will then be added back into the Available Procedures list box

Once all of the selections have been made, click **Save** to save this QC sequence or save it under another name using the **Save As** button. This process may be repeated to prepare all of the QC sequences needed. Once this is done, click **Finish** to exit Sequence Manager or **Back** to return to the initial Sequence Manager screen.

Super Sequence

A Super sequence an extremely powerful feature of Eclipse LB. Any batch template, uncounted batch, QC sequence, calibration procedure with Use for QC checked, or sample counting procedure is available for use in a Super sequence. A Super sequence is created by starting the Sequence Manager, clicking on *Super Sequence* then **Next**. The Sequence Manager: Super screen is displayed.

If no super sequences have been previously created, click **New** and enter an appropriate sequence name (Figure 130).

The *Sequence Name* can be up to 35 characters long. The symbols, \ / : * ? “ < > and | can not be used. The sequence name should be sufficiently descriptive that you will clearly understand the data acquisition and analysis details of this sequence, when choosing it for execution.

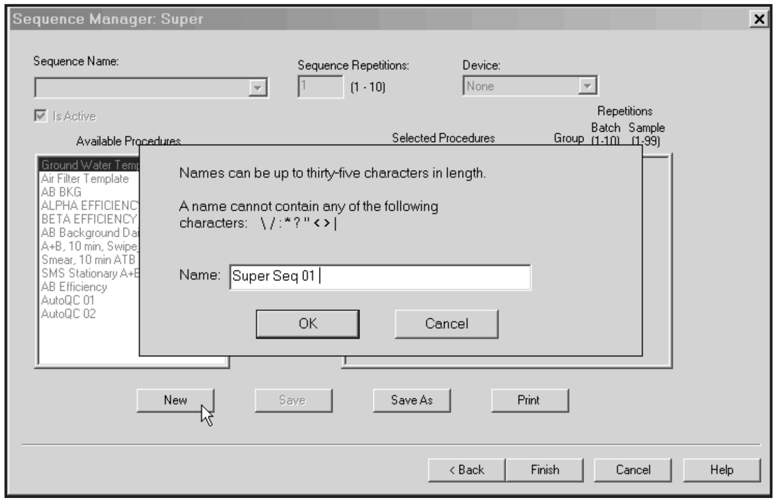


Figure 130 Naming a Super Sequence

After clicking **OK**, the sequence name will then appear in the *Sequence Name* list. Eclipse LB will automatically save this sequence as “active” (Figure 131).

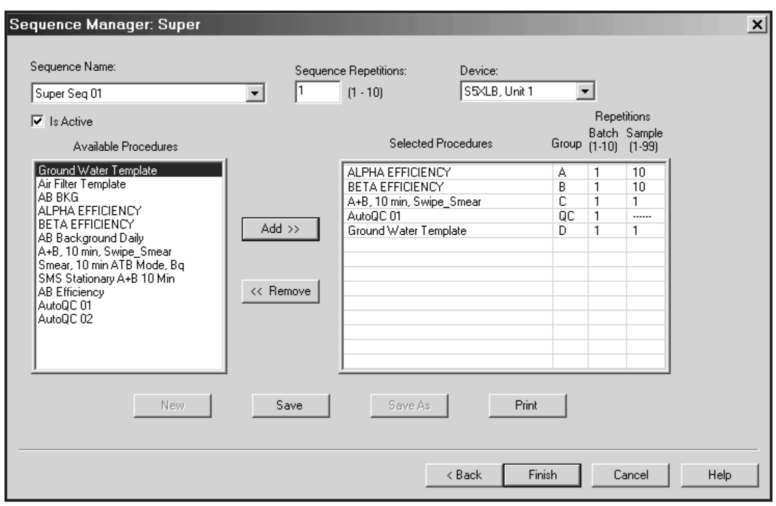


Figure 131 Super Sequence Screen

The following options are available for the creation of a super sequence. If any of these options/values are changed, the sequence must be saved once again.

Sequence Repetitions

Selectable from 1 to 10; default is 1.

This is the number of times the entered Super sequence is repeated.

Device

Any registered counting system; default is *None*.

This selection will override any predefined devices within the individual procedures making up this sequence. Note: this option requires firmware version 3.0 or higher.

Is Active

Selecting the Is Active check box will change an active status to inactive and an inactive status to active. The default for Super sequence is Active. Inactive sequences are not available for use.

Available Procedures

This is a list of all active Unknown procedures, all active SMS procedures (if the option has been installed), all calibration type procedures that have the “Use for QC Only” check box selected, and all AutoQC sequences. Also included are all pre-entered batches that, when defined in the Sample Manager, were associated with a particular procedure. A vertical scroll bar will appear, if necessary, to allow viewing of all procedures in the list box.

Notes: AutoCal sequences can not be added to a Super sequence definition.

All active procedures listed in the Available Procedures list box can be added multiple times to the sequence but the group plates must be unique.

An AutoQC sequence can be added to a Super sequence multiple times only if they are the same sequence. Two or more different AutoQC sequences cannot be added to the same Super sequence.

Selected Procedures

This is a list of all procedures that currently define the sequence. A vertical scroll bar will appear, if necessary, to allow viewing of all procedures in the list box. A maximum of 21 procedures can be listed.

Notes: The sequence will execute in the order the procedures are listed in the Selected Procedures list box, regardless of the order in which the group plates are stacked on the sample changer.

If the Super sequence does not contain any AutoQC sequences then the maximum number of items in the selected list will be ten (groups A through J).

Within this list box you will also have the option of overriding the *Group* if it has been previously defined in the procedure. If the group has not been previously defined then it must be defined at this time. No two procedures can be defined with the same group except for AutoQC which will automatically be defined as QC group plate.

Batch Repetitions and Sample Repetitions

Defaults to the value defined in the procedure. These values can be changed. If any of these parameters are predefined then there values will be displayed. For AutoQC sequences the sample repetition field does not apply and the batch repetition is displayed as 1.

Add Button

The **Add** button is used to add the item selected in the Available Procedures list box to the Selected Procedures list box. This selection *will not* be removed from the Available Procedures list box.

Remove Button

The **Remove** button is used to remove the procedure selected in the Selected Procedures list box to the Available Procedures list box. This selection will then be added back into the Available Procedures list box

Once all of the selections have been made, click **Save** to save this Super sequence or save it under another name using the **Save As** button. This process may be repeated to prepare all of the sequences needed. Once this is done, click **Finish** to exit Sequence Manager or **Back** to return to the initial Sequence Manager screen.

When a Super sequence is launched the instrument will be queried to determine if any of the groups defined in the sequence are already enabled. If so then an error message will appear and the sequence will be prevented from executing.

Note: The maximum number of Super Sequences that can be active at any one time is five.

Starting a AutoCal, AutoQC, or Super Sequence

Once a counting sequence has been created for a series of procedures, it can be selected to run.

Begin a counting sequence by clicking on **Count | Go** or the **Go** button. The **Start a Count** dialog box (Figure 132) appears. Select the counting sequence to be used (i.e., AutoCal, AutoQC, or Super). The Device list will display the device or system selected when the sequence was defined. Click **OK** to begin.

Depending on the counting sequence selected, the Group list box will display:

- N/A for Super sequences since each procedure within the sequence will have its own pre-defined group plate.
- Cal for AutoCal sequences.
- QC for AutoQC sequences.

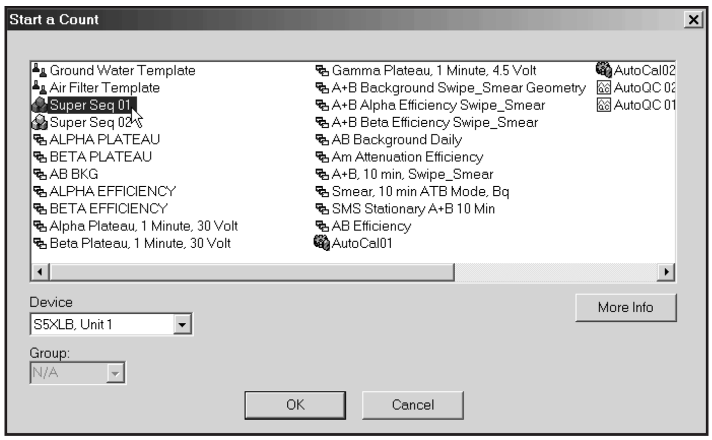


Figure 132 Selecting Super Sequence for Counting

The **More Info** button will display additional information about the counting sequence selected as follows:

- For Super Sequences this button will display a brief summary of the sequence parameters (Figure 133).

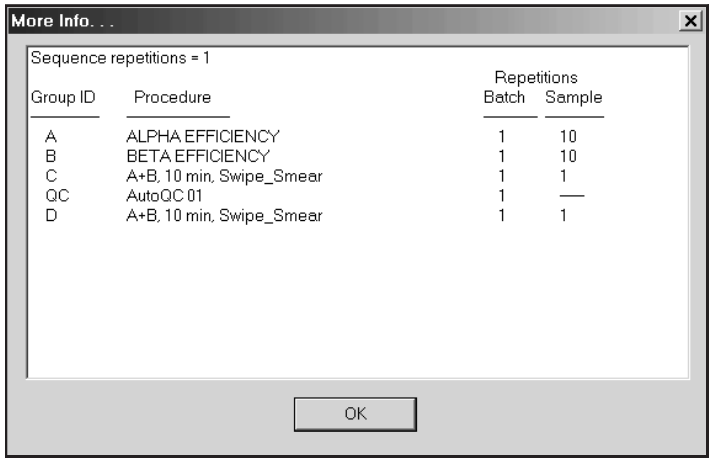


Figure 133 Summary of Super Sequence Parameters

- For AutoCal and AutoQC Sequences this button will display a brief summary of the sequence parameters (Figure 134).

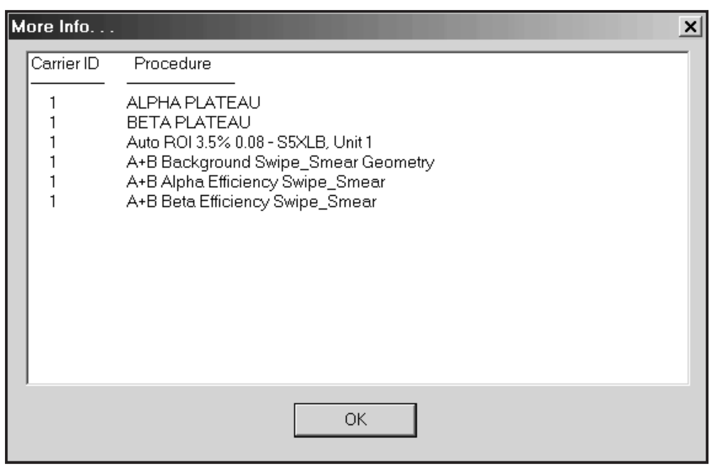


Figure 134 Summary of Auto QC Sequence Parameters

Creating an Auto ROI Procedure

The discriminator settings determined by an Auto ROI procedure are defined by the Amplifier Setup - Alpha/Beta Auto screen. To create an Auto ROI procedure, the following steps are performed:

1. Select **System | Alpha/Beta Amplifier Setup | Auto**. If more than one device is active on the system, select the *Device* to be setup from the Select Devices dialog box (Figure 135) and click **OK**.

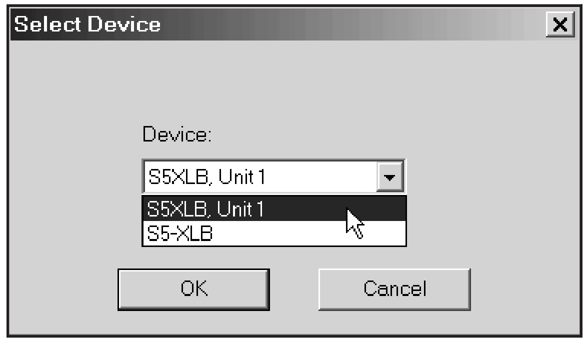


Figure 135 Select Device Dialog

2. The Amplifier Setup - Alpha/Beta: Auto screen (Figure 136) appears. Enter the Beta Loss and Accuracy and the Beta → Alpha Spillover and Accuracy in percent.

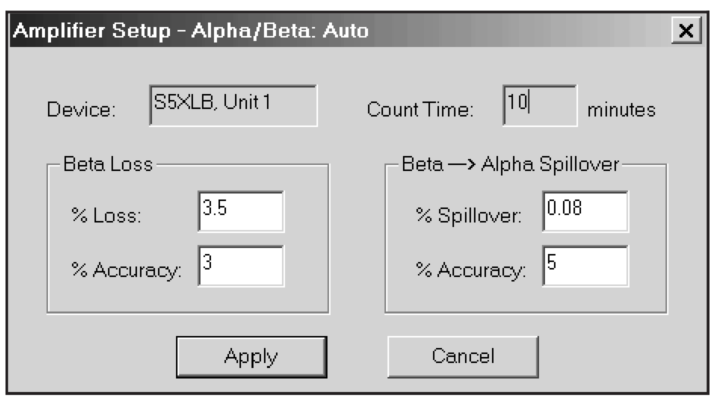


Figure 136 Amplifier Setup - Auto Screen

3. Click on **Apply** and select *<new>* in the Select Region dialog box (Figure 137). Click on **OK**.

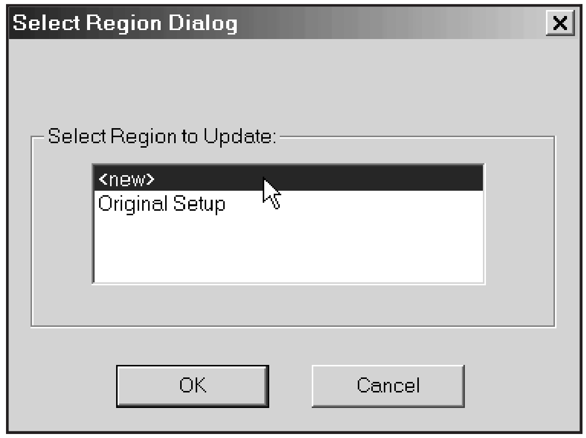


Figure 137 Select Alpha/Beta Region Dialog

4. Enter a name that defines the *Alpha/Beta Amplifier Setup* adjustments made and click on **OK** to save (Figure 138). The procedure name will be appended with the name of the device..

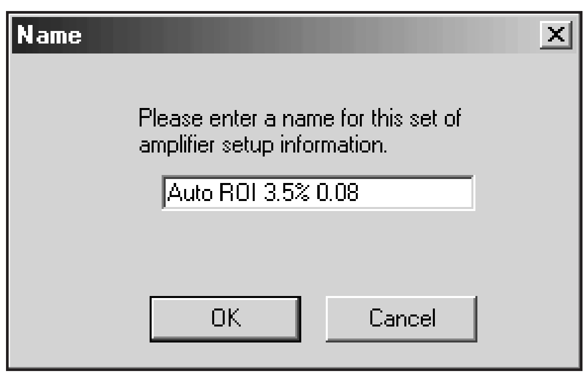


Figure 138 Entering Auto ROI Procedure Name

Once the procedure is defined and named it can be selected within the Auto Cal Sequence, refer to “Automatic Calibration (AutoCal)” on page 155 for more details.

11. Security Setup

The Security feature of Eclipse provides the System Administrator, and other authorized users, the ability to control access to system features by other users. System features include such features as the ability to create and maintain a database of users, their group assignments and the security objects each group can access. The Security Setup screen (Figure 139) can be initiated by selecting the **Security** button (Key and Lock) from the toolbar or **Security** in the System drop down menu.

Only the users in the with one or both of the rights "Create/Edit/Delete Groups" or "Create/Edit/Delete User" have access to this page; its functions will be unavailable for all other users. When a user with one, but not both, of the aforementioned rights views the screen, they will only be able to edit the entity, groups or users, to which they have rights.

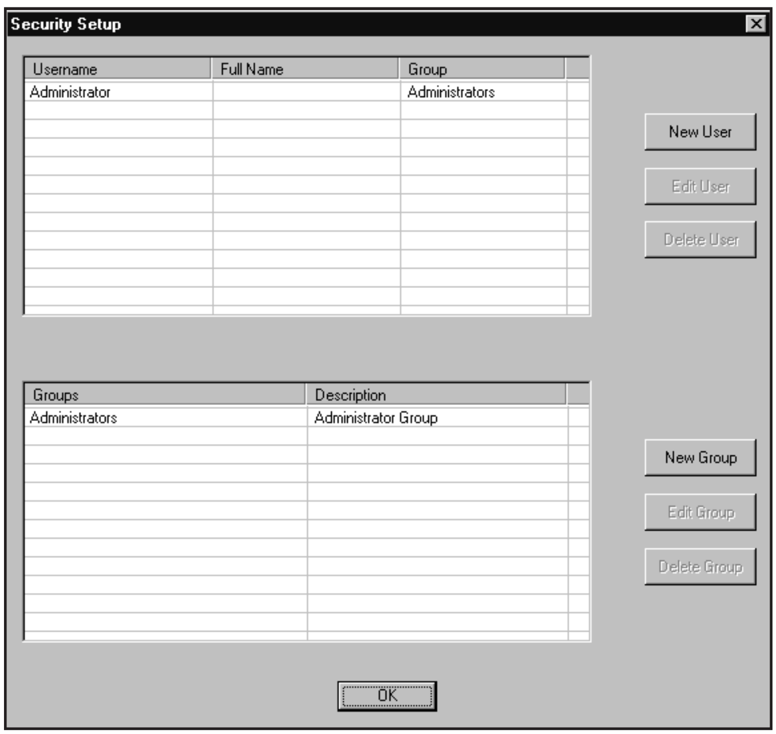


Figure 139 Security Setup Screen

New/Edit User Button

Click **New User** to create or **Edit User** to edit a User Name and Password and assign or change the user’s Group (Figure 140). The user’s security rights are those of the assigned group.

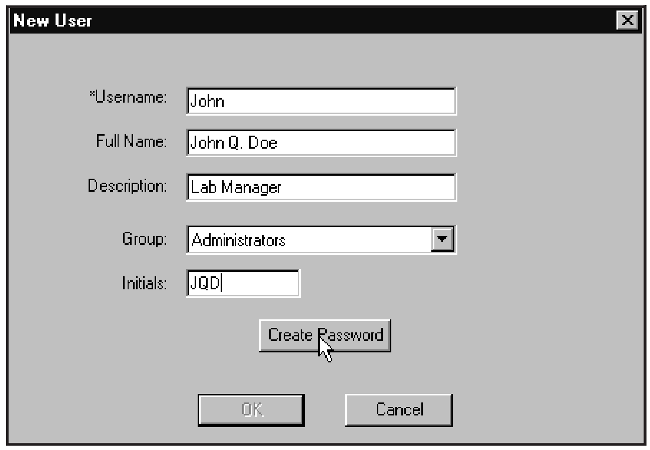


Figure 140 Edit User Dialog

*Username

This field is required; it must be between 1 and 16 characters.

Full Name

This is the user's full name. This optional field can be up to 64 characters.

Description

This is a description of the user. This optional field can be up to 255 characters.

Group

Select the Group that this user is to be assigned to.

Initials

This is the initial of the user. This optional field can be up to 6 characters

Create/Edit Password

Click this button to create a password for a new user or change the password for an existing user (Figure 141).

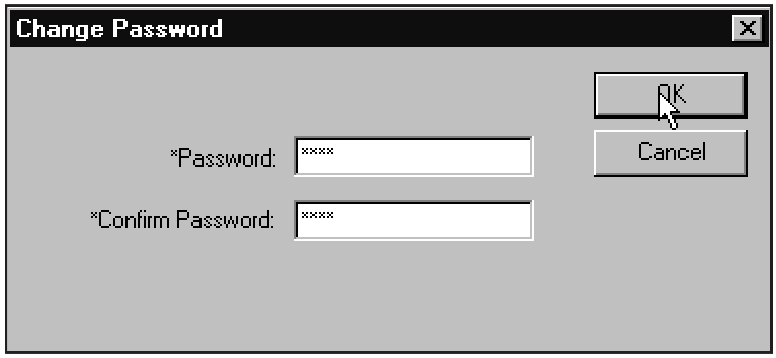


Figure 141 Changing the Password

***Password**

This field is required; it must be between 1 and 16 characters and is case sensitive.

***Confirm Password**

After typing in the Password, type it again in the Confirm Password field for confirmation.

Delete User

Click the **Delete User** button to remove the selected user definition.

Note: The Administrator user cannot be deleted.

New/Edit Group Button

Click **New Group** to create a new group or **Edit Group** to edit an existing group's Description and Security Rights (Figure 142).

Notes: A new group has no default rights to Eclipse functions; rights *must* be assigned here before the group can use the system.

The Administrator Group has all rights assigned; these cannot be changed.

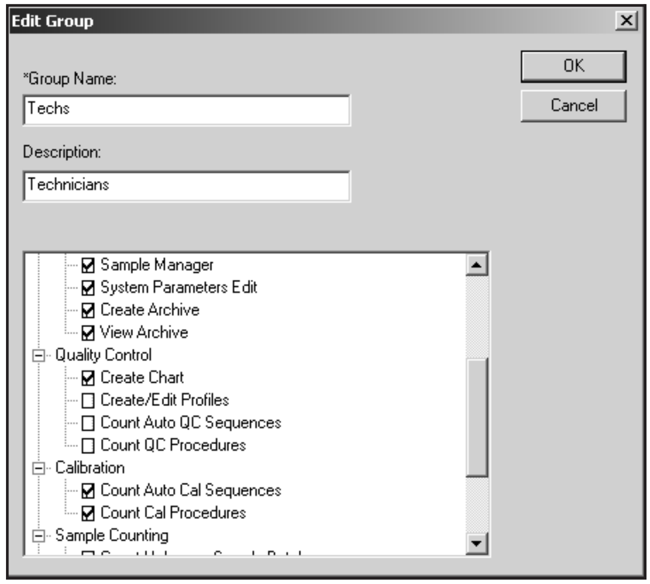


Figure 142 Edit Group Dialog

*Group Name

This is the name of the group. This optional field can be up to 32 characters. Up to ten groups can be created.

Description

This is a description of the group. This optional field can be up to 255 characters.

Security Rights

Below the Group Name and Description are the security rights for Eclipse. A summary of the Eclipse rights is given below:

Category	Right	Description
General		
	Recall Batch	If this right is not selected the Recall Batch menu item and Icon will be unavailable
	Customize colors	Can change foreground and background colors of the Sample Display screen
	Set default window size	Can change the size of the Sample Display screen
	Set column widths	Can change the column widths of the Sample Display screen
Admin Functions		
	Database Utilities	Can mark as current, use for QC, create devices, create sources, etc.
	Procedure Manager	Can create and/or edit all types of procedures
	Sequence Manager	Can create and/or edit all sequence types
	Sample Manager	Can create and/or edit all sample information
	Edit System Parameters	Can edit system parameters such as: Gas Con, Amp Setup
	Create Archive	Can create an archive database
	View Archive	Can view an archive database
	Delete Batches	Can delete batches from active database
Quality Control		
	Create a Chart	Can create QC Charts
	Create/Edit Profiles	Can create and/or edit all QC Profiles
	Count Auto QC Sequences	Can perform an Auto QC Sequence
	Count QC Procedures	Can perform a counting procedure marked with use for QC

Calibration		
	Count Auto Cal Sequences	Can perform an Auto QC Sequence
	Count Cal Procedures	Can perform a calibration procedure such as: Plateau, Efficiency or Background
Sample Counting		
	Count Unknown Sample Batches	Can run a sample batch
	Count Procedures	Can perform a counting procedure
	Count Super Sequences	Can perform a Super Sequence
Security		
	Create/Edit/Delete Groups	Can create, and/or delete all groups
	Create/Edit/Delete Users	Can create, and/or delete all users

Delete Group

Click the **Delete Group** button to delete the highlighted group.

Notes: A group cannot be deleted if users are still assigned to it. The user's group assignments must be changed in User Edit or the users must be deleted from the system before the group can be deleted.

The System Administrator group cannot be deleted.

12. System Overview

The Tennelec Series 5XLB Automatic Low Background Alpha/Beta Counting System, along with a Personal Computer, form an integrated system for the processing of radioactive samples. The system provides quantified data for alpha and beta nuclides present in the samples.

The system features an automatic sample changer that allows unattended operation of 50 (and optionally 100) samples.

Sample Changer

Sample Changer Mechanism

The Automatic Sample Changer (Figure 143) is comprised of two gear trains and electronic sensing devices that indicate the positional status of the sample changer. The gear trains are driven with independent motors: one to drive the *crossfeed helix* and one to drive the *insertion helix*.

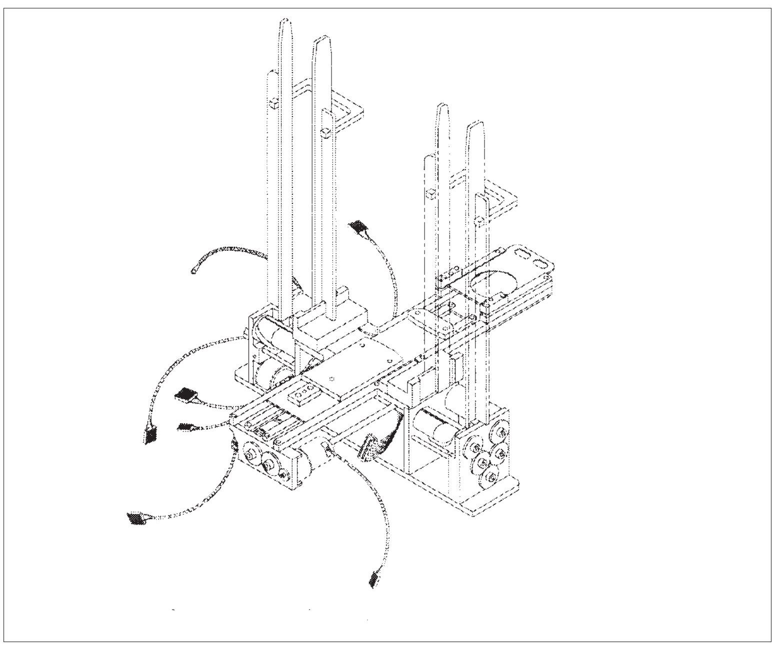


Figure 143 Series 5 Sample Changer

Infrared photosensors are used to read sample numbers in a BCD (binary coded decimal) arrangement.

Sample Reader

The sample reader assembly comprises nine pairs of photosensors. Eight of these are oriented in a straight line and constitute the sample reading capability. One pair, offset from the other eight pairs, is used to read one of the holes in the END plate (SEND STACK EMPTY). The devices are assigned specific bits in a binary coded decimal configuration. From front to rear, they are: 10, 20, 40, 80, 1, 2, 4, 8, and SEND STACK EMPTY.

The decoding of a sample number (Figure 144) is a summation of the holes in the sample carrier or GROUP plate. The maximum decimal number that can be derived is 165. Sample carriers use numbers 1-150. Group plates use numbers 151-160. Numbers 161-165 are not used in the system. End plates use a special code arranged outside the holes for binary coded decimal configuration.

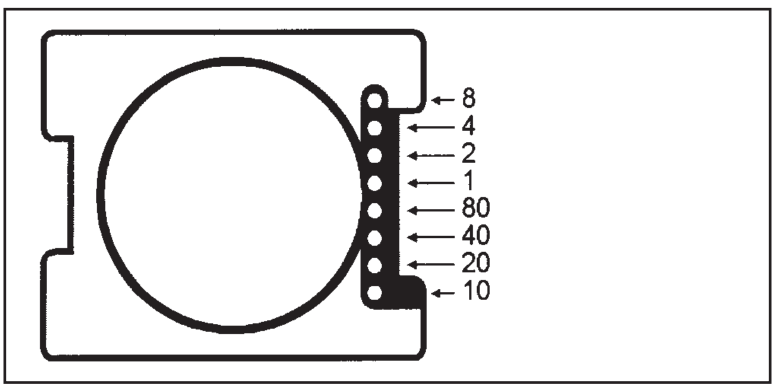


Figure 144 Series 5 and LB5100 Sample Carrier

An optional bar-code reader can be mounted on the sample changer. Special sample carriers and sample cards are required for operation with the bar-code reader.

Sample Changer Operation

Sample carriers are loaded onto the right side of the changer in a vertical configuration and maintained in position by the sample masts. The sample carriers have different width notches on each side of the carrier so that they cannot be inserted into the sample stack backwards. When the *crossfeed* is operating in the forward or advance direction, a rectangular-shaped sample carrier drops into position. Then a pair of drive cams, known as helixes, rotating in opposite directions, will push the carrier under the sample reader. When a sample number is recognized, the cams will push the sample carrier onto the sample slide. The crossfeed motor stops when INDEXED. At this time, the insertion motor is actuated and positions the sample under the detector. When the system has counted for the pre-selected time or preset counts, the slide is withdrawn, and stops when fully extended, and the slide-out sensor has been activated. The crossfeed motor is once again turned on, and another carrier is pushed into position on the slide. Samples that have been counted are pushed to the left side of the sample changer and maintained in position by another set of sample masts.

INDEXING is accomplished by means of an aluminum disc with a slot (attached to the left crossfeed gear train) and a single photosensor pair. When the slot in the aluminum disc is aligned with the sensor, the changer is at the INDEX position. The INDEX condition coincides with the mechanical alignment of the sample carrier with the sample reader and indicates to the controller board that a sample carrier is in the proper position to reliably read the sample carrier number.

SLIDE IN and SLIDE OUT status is accomplished by using a pair of photosensors and a small aluminum tab mounted on the sample slide. Underneath the sample slide, the sensors for detecting SLIDE IN and OUT are mounted on the inside of the front and rear bearing plate for the insertion helix. A small piece of metal is attached to the slide. When the slide reaches full IN or OUT and the metal gate blocks the gap between the sensor, the photosensor pair is activated and the controller board senses the information.

Sample counting continues until there are no longer any sample carriers in the right-hand (SEND) mast and an END plate is pushed underneath the sample reader. The *send stack empty* photosensor is actuated by the holes in the END plate.

Lead Shield

The Tennelec Series 5 incorporates a modular cast-lead shield assembly that can be configured for several background / weight combinations. The individual lead shield components have a maximum weight of 60 lbs. to facilitate the assembly of the lead shield.

The fully assembled lead shield is shown in Figure 145.

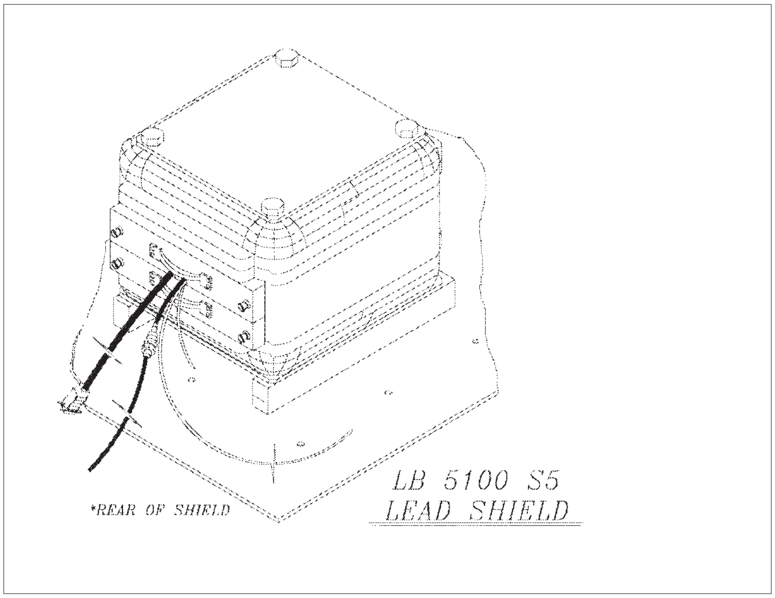


Figure 145 Fully Assembled Lead Shield

Gas System

Gas Regulation and Control

The system P-10 counting gas is supplied from a high-pressure (3000 psi) gas cylinder. A single-stage regulator is mounted to the cylinder and regulates the gas pressure delivered to the system at 10 ± 1 psi. The low-pressure gas is routed to the system using flexible plastic tubing.

The 10 ± 1 psi low-pressure gas is applied to an electronic pressure controller that regulates the system gas flow rate by varying the pressure applied to a precision porous metal flow restrictor. Over the range of system gas flow rates, the output flow rate is a nearly linear function of the applied gas pressure.

A low gas warning is issued from the controller and the system is disabled (gas mode is set to OFF/HV DISABLE) if the input pressure falls below 5 psi.

The Tennelec Series 5 optionally includes a gas conservation system to reduce the consumption of the P-10 counting gas. An electronic pressure regulator valve allows the system gas flow-rate to be automatically tailored to the system operational status. For more information on GasStat and Gas Mode systems, refer to Chapter 14, *Gas System*.

Detectors

The detector assembly consists of a 2.25-inch-diameter sample detector shielded by a large-area guard detector. Both detectors are a gas-flow proportional type and operate with P-10 gas.

Sample and Guard Detector

The sample detector is a 2.25 inch diameter pancake style gas-flow proportional detector. The detector features twin anodes for excellent counting uniformity and an ultra-thin 80 $\mu g/cm^2$ entrance window for high counting efficiency.

The guard detector is a large-area gas-flow proportional detector with six anode wires for excellent counting uniformity. The bottom of the guard detector is contoured to encompass the sample detector, thus reducing the exposure of the sample detector to unguarded external background sources.

Preamplifier

The system incorporates individual charge-sensitive preamplifiers for both the sample and guard detectors. The preamplifiers also distribute the high voltage bias to the detectors.

Amplifier/SCA

The system amplifier/SCA board contains separate amplification/shaping/discrimination sections for the Guard and Sample channel information. The output of the Guard amplifier feeds a discriminator whose threshold is set by the system controller card. The output of the Sample amplifier feeds one threshold (β lower) and two discriminators (β upper and α lower) whose settings are modified by the system controller card. The discriminator outputs from both the Guard and Sample channels are routed to the counters on the controller card. The board also contains count activity indicators and a variable amplitude test pulsar.

System Controller

The Tennelec Series 5 contains a single board microprocessor based controller and real time operating system, that provides the functions necessary to control the counting capability of the instrument. The controller is responsible for all sample changer movement, count parameter management, sample data counting, count data management, gas and high voltage control, system control panel, external communications, and internal system diagnostics.

IEEE-488 Address

DIP (Dual IN-line Package) switches have replaced the IEEE address jumpers of the previous versions of automatic systems. The Figure 146 shows the switch settings for a typical Series 5 system addressed as DEV1 and not using a bar-code reader or a windowless detector.

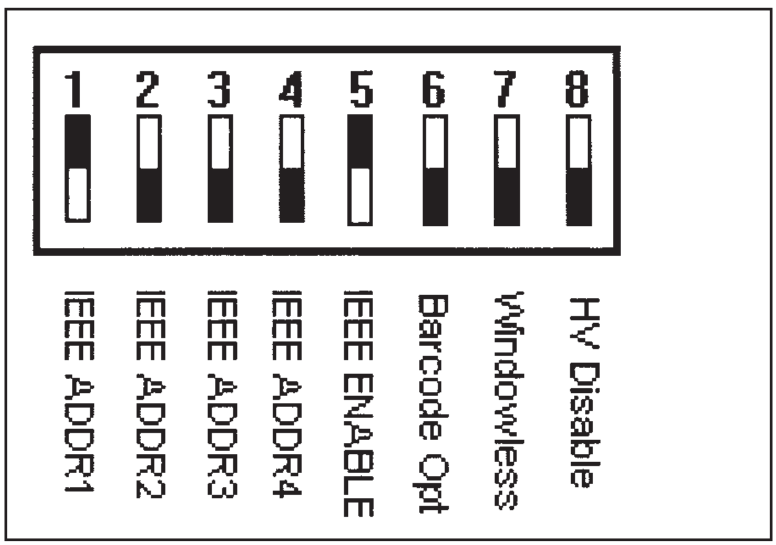


Figure 146 DIP Switch Settings

The following shows the function of each switch:

IEEE ADDR1	BIT 0 of the binary address. This switch will be on when the system is addressed a DEV1, DEV3, DEV5, DEV7 ,DEV9, DEV11, DEV13, and DEV15.
IEEE ADDR2	BIT 1 of the binary address. This switch will be on when the system is addressed a DEV2, DEV3, DEV6, DEV7, DEV10, DEV11, DEV14, and DEV15.

IEEE ADDR3	BIT 2 of the binary address. This switch will be on when the system is addressed a DEV4, DEV5, DEV6, DEV7, DEV12, DEV13, DEV14, and DEV15.
IEEE ADDR4	BIT 3 of the binary address. This switch will be on when the system is addressed a DEV8, DEV9, DEV10, DEV11, DEV12, DEV13, DEV14, and DEV15.
IEEE ENABLE	The switch should always be on.
BARCODE OPT	This switch is on if the system is equipped with a bar code reader.
WINDOWLESS OPT	This switch is on only if the system is equipped with the windowless option and is being operated in windowless mode.
HV DISABLE	The switch is only turned off for diagnostic purposes.

Control Panel

A control panel provides system status information and allows you to have manual control of the sample changer when needed.

System Status

The tri-color System Status serves as a visual indicator of the overall system operational status.

The System Status indicator illuminates *green* for normal operational status.

The System Status indicator illuminates *yellow* if a low input gas pressure is detected.

The System Status indicator illuminates *red* if a system fault is detected. This includes an internal power supply that is out of tolerance, low battery voltage, high voltage fault or excessive motor current during sample changer operation.

Sample Changer Control

AUTO and MANUAL

The Auto and Manual push-buttons select the sample changer mode.

The automatic mode is the default mode in which all changer operations occur as dictated by the system controller. A green indicator, located behind the Auto push-button, is illuminated any time the system is in automatic mode.

The manual mode is used in special cases where it is necessary for the user to control sample changer movement. A yellow indicator, located behind the Manual push-button, is illuminated any time the system is in manual mode.

Manual mode takes effect immediately when the button is pressed and stops any changer operation in progress. Since the changer is stopped, the Halt indicator (described below) is illuminated.

COUNT and HALT

The Count and Halt buttons have a dual purpose. When the system is analyzing a sample, the Halt button serves to stop the count. This feature can be useful when calibrating the system. A red indicator behind the Halt button illuminates when the system is paused. Pressing the **Count** button restarts counting and illuminates the green Count indicator. The red Halt indicator will flash during sample changer operation.

If the system is not analyzing a sample, the Halt button stops the sample changer and places the system into manual mode.

IN and OUT

These push buttons are enabled only when the Manual indicator is illuminated. The In button takes the slide into the detector drawer. The Out button pulls the slide out of the detector drawer.

ADVANCE and REVERSE

The Reverse push-button is enabled only when the Manual indicator is illuminated. The Reverse button moves the stack one carrier to the right.

The Advance button is enabled whether or not the Manual indicator is illuminated, but serves a different purpose in each case. In manual mode, the Advance push-button moves the stack one carrier to the left and stops. In Auto mode, the Advance push-button causes the next carrier to be placed in the lead cave and counted. When finished, the changer will again advance and repeat the sequence.

RESTACK

This button has the same function as the Reverse button except that the changer moves all the sample carriers to the load stack. This function can be helpful if it is necessary to remove a stack of carriers in the same order as they were loaded.

Power Supply

The system requires connection to the ac mains for operation. The unit features a universal-input power supply that accepts ac mains power from virtually any country.

13. Upgraded System Instructions

Older Tennelec LB systems like the LB5100-I, II, III, and Z that have been updated to the Windows 3 environment can be easily upgraded to Eclipse. This upgrade provides many of the advantages of the new operating system.

Newer systems like the LB5100-W and LB5100-IV enjoy most of the basic functionality of the software as a Series 5 system. There are some differences in the setup and operation. This chapter will address many of the differences.

System Addressing

Placing jumpers on the appropriate sets of pins sets the IEEE address of the system. If a system is to be addressed as Device 1 (DEV1) without a bar-code reader, there need to be jumpers on BIT 0 and IEEE Enable. If a system is to be addressed as DEV3, there should be jumpers on BIT 0, BIT 1, (1+2=3) and IEEE Enable. A system addressed as DEV15 would need jumpers on BIT 0, BIT 1, BIT 2, BIT 3(1+2+4+8=15), and IEEE Enable.

Non-NIM Bin Based Instruments

The operation of non-NIM based instruments similar to the Tennelec LB5100-W and the Tennelec LB5100 Series 4 is very similar to the operation of the Series 5. The major difference is the lack of gas flow regulation and conservation. These features are not retro-fitable into the old systems. Most other features should emulate a Series 5.

NIM Bin Based Instruments

Tennelec systems with NIM Bins like the LB5100-I, II, series III, and LB5500 can be operated by Eclipse software. Even though all the features of the Series 5 cannot be reproduced, the ease of operation and incredible flexibility of Eclipse can be utilized.

Automatic Gas Flow Regulation

The automatic gas flow regulation is not retro-fittable into the NIM based systems. The original flow meter will have to be used.

ROI Setup - Spillover

After running a plateau, the alpha discriminators should be adjusted to minimize false readings of alphas counted as betas and beta counted as alpha. The Tennelec LB5100 and LB5500 use pulse height discrimination to determine if an event should be scaled into the alpha or the beta counting channel. For any given isotope, the measured pulse height will not be absolutely constant but will vary slightly from one measurement to the next.

The Tennelec LB5100-I, II, III, and LB5500 use one discriminator level to distinguish between alpha and beta particles. The NIM Module TC265A is the sample channel amplifier and SCA (Single Channel Analyzer).

TC265 Settings

Gain:	16
α Discriminator:	Varies
$\alpha+\beta$ Discriminator:	Fully CCW or .25

TC264 Settings

Gain:	64
Discriminator:	Fully CCW or .50

Adjusting Channel Discriminators

This section discusses the ROI calibration procedure for systems equipped with a NIM BIN only. On LB5100-W and LB5100-IV systems, use the ROI calibration procedure in section.

It is recommended that you follow along by actually performing the operations described in the example.

1. Close all Eclipse Batch windows. The **Amplifier Setup** command is not available unless there are no Batch windows open.
2. Select **System | Amplifier Setup**.
3. Load a pure beta emitting standard (for example, ^{90}Sr) behind a group plate.
4. On the Amplifier Setup screen, choose the device and group then press the **Start Count** button.

5. The system should move the sample into position and begin counting. *Always allow 10,000-30,000 counts to register before making a determination on spill.* The goal is to set the Beta into Alpha spill to 1.0% ± 0.05%. Press the **Halt Count** Button.

6. If the Beta into Alpha spill is greater than 1.05%, turn up the α Discriminator on the 265A NIM Module. If the Beta into Alpha spill is less than 0.95%, turn down the α Discriminator. Press the **Resume Count** button.

7. Continue performing the previous step until the Beta into Alpha spill is 1% (0.95-1.05%). Press the **Apply** button if there are no non-NIM based sharing this computer. Enter the name of this ROI set in the space provided and press **OK**. The NIM based system does not use the ROI that is set. If there are non-NIM based systems connected to this computer simply press cancel.

Note It is recommended to enter a name the first time this procedure is run and then selecting cancel subsequent times. This allows for the use of the same count profiles without updating the existing procedures.

8. Once this procedure is completed, it is recommended that the detector be re-calibrated. Minor changes in the ROI setting will not radically change the background. Many facilities have chosen to disregard the differences in the backgrounds with different ROI settings, so long as the count mode is consistent.

Upgraded Hardware Specifics

Detector Replacement (LB5100-W-GWD)

The detector assembly can be accessed without having to disassemble the lead shield. To gain access to the detector, perform the following:

1. Remove ac power from the system.

2. At the rear of the system, loosen the four knurled screws retaining the access panel on the top-rear shroud.

3. Disconnect the black High Voltage cable from the back of the system.

4. Disconnect the ground strap from the back of the drawer. These are quick-connect and can be pulled loose.

5. Disconnect the quick-connect gas fitting.

6. Remove the four corner counter-sunk Phillips-head screws from the aluminum panel located in the center of the lead shield. Remove the rear cover.

7. Grasp the top lead brick by the handle and remove it. Grasp the handle of the bottom lead brick and remove it.

8. Remove the two screws holding the detector in place.

9. Grasp the detector Pre-amp assembly and withdraw completely. Place it on a table or work bench.

10. Disconnect the gas lines.

11. Pick up the (top) guard detector and lift it up and OFF the platform.

12. Remove the Phillips head screw from the LEXAN cover.

13. Remove the cover.

14. Remove the 1700-0178 sample preamplifier card (the smaller of the two cards).

15. Remove the (bottom) sample detector.

CAUTION The detector window is exposed at this time. Be very careful to not damage the window.

16. Before installing the detector back into the shield, take a few minutes to inspect and clean the inside of the shield, using alcohol.

17. Position the new detector onto platform, paying particular attention to prevent the retaining stud from inadvertently puncturing the window. Ensure that the window ring comes to rest within the mating hole on the detector cradle.

18. Repeat the previous steps in reverse order.

19. Insert the slide with a sample insert in place. Submerge the gas vent line approximately 1/8 inch below the surface of a container of liquid and ensure that bubbles are produced. If not, immediately disconnect the gas quick-connect fittings and investigate for possible crimping of the gas line within

the shield area. Failure to do this may result in damage to the window on the sample detector.

20. With the gas-flow integrity having been verified, proceed with the attaching the high voltage cable.

21. Apply power to the system and test for proper operation. You should always perform a plateau when installing a new detector. Calibrate the system.

Detector Replacement (LB5100-W)

The detector assembly can be accessed without having to disassemble the lead shield. To gain access to the detector, perform the following:

1. Remove ac power from the system.

2. At the rear of the system, loosen the four knurled screws retaining the access panel on the top-rear shroud.

3. Disconnect the black High Voltage cable from the back of the system.

4. Disconnect the ground strap from the back of the drawer. These are quick-connect and can be pulled loose.

5. Disconnect the quick-connect gas fitting.

6. Remove the four corner 6-32 Phillips-head screws from the aluminum panel located in the center of the lead shield.

7. Grasp the aluminum handle and withdraw the detector drawer six to seven inches.

8. Note the three pieces of lead shielding on the drawer. These are attached with two retaining bolts and weigh 30-35 pounds.

9. Grasp the side of the drawer with your free hand to afford more support, withdraw the detector drawer completely, and set on a table or work bench.

10. Disconnect the gas lines.

11. Using a straight screwdriver remove the screw that holds the aluminum strap to the retaining studs. Set aside the strap.

12. Pick up the (top) guard detector and lift it up and OFF the platform.

13. Remove the Phillips head screw from the LEXAN cover.

14. Remove the cover.

15. Remove the 1700-0178 sample preamplifier card (the smaller of the two cards).

16. Remove the (bottom) sample detector.

CAUTION The detector window is exposed at this time. Be very careful to not damage the window.

17. Before installing the detector back into the shield, take a few minutes to inspect and clean the inside of the shield, using alcohol.

18. Position the new detector onto platform, paying particular attention to prevent the retaining stud from inadvertently puncturing the window. Ensure that the window ring comes to rest within the mating hole on the detector cradle.

19. Repeat the previous steps in reverse order.

20. Submerge the gas vent line approximately 1/8 inch below the surface of a container of liquid and ensure that bubbles are produced. If not, immediately disconnect the gas quick-connect fittings and investigate for possible crimping of the gas line within the shield area. Failure to do this may result in damage to the window on the sample detector.

21. With the gas-flow integrity having been verified, proceed with the attaching the high voltage cable.

22. Secure the detector drawer into place using the four 6-32 Phillips screws.

23. Apply power to the system and test for proper operation. You should *always* perform a plateau when installing a new detector. Calibrate the system.

Detector Replacement (NIM-based system)

The detector assembly can be accessed without having to disassemble the lead shield. To gain access to the detector, perform the following:

1. Remove ac power from the system.

2. At the rear of the system, loosen the four knurled screws retaining the access panel on the top-rear shroud.

3. Disconnect the black HV/Signal cables labeled SAMPLE and GUARD from the INPUT connectors of the TC175B preamplifiers.

4. Disconnect the ground straps from the front panels of the preamplifiers. These are quick-connect and can be pulled loose.

5. Disconnect the quick-connect gas fitting.

6. Remove the four corner 6-32 Phillips-head screws from the aluminum panel located in the center of the lead shield.

7. Grasp the aluminum handle and withdraw the detector drawer six to seven inches.

8. Note the two pieces of lead shielding on the drawer. These are attached with a retaining bolt, but weigh 30-35 pounds.

9. Grasp the side of the drawer with your free hand to afford more support, withdraw the detector drawer completely, and set on a table or work bench.

10. Disconnect the two cables from the detectors.

11. Disconnect the gas lines.

12. Using a 1/4-inch nut driver or socket, remove the “kep” nut that retains the copper strap to the retaining stud. Set aside the ground strap.

13. Lift the copper strap up and pivot to the side.

14. Pick up the detector by the connector end and lift it up and off the platform. *Exercise caution when handling the detector; the entrance window can be easily damaged.*

15. Position the new detector onto platform, paying particular attention to prevent the retaining stud from inadvertently puncturing the window. Ensure that the window ring comes to rest within the mating hole on the detector cradle.

16. Attach the High Voltage signal cables with the Guard cable to the top connector, and the Sample cable to the lower connector.

17. Attach the gas lines so that the Gas In tube connects to the bottom detector, and the vent line to the top detector.

18. Pivot the copper retaining strap and position onto the retaining stud.

19. Position the ground strap onto the retaining stud and secure firmly, but not too tightly, using the 4-40 x 1/4-inch hex kep nut.

20. Before installing the detector back into the shield, take a few minutes to inspect and clean the inside of the shield, using alcohol.

21. Install the detector drawer back into the shield and slide in about half way.

22. Orient the cables and gas lines within the slots of the lead brick so that they will not be damage or crimped when the drawer is fully inserted.

23. Join the two mating gas line quick-connect fittings and twist to lock in place.

24. Submerge the gas vent line approximately 1/8 inch below the surface of a container of liquid and ensure that bubbles are produced. If not, immediately disconnect the gas quick-connect fittings and investigate for possible crimping of the gas line within the shield area. Failure to do this may result in damage to the window on the sample detector.

25. With the gas flow integrity having been verified, proceed with the attaching the high voltage/signal cables to the inputs of their respective preamplifiers.

26. Attach the ground straps to the front panel of the preamplifiers.

27. Secure the detector drawer into place using the four 6-32 Phillips screws.

28. Apply power to the system and test for proper operation. It is always best to perform a plateau when installing a new detector. Calibrate the system.

Sample Changer Considerations

Should you have one of the early-style changers, there are a few items worthy of considering for upgrade.

Sample Changer Wiring Harness

Early-style changers used a single-sided circuit board with precise orientation of photo-devices to detect the sample carrier. Pins of devices were inserted straight through and soldered. Problems have been noticed from a lack of strain relief where the wires were soldered to the 25 pin D-connector. Problems were seen in form of broken wires, and solder connections would fatigue due to vibration of the changer. New-style harnesses utilize double-sided board material. Some holes are plated through, but the photo sensors are inserted and then the pins are bent over and soldered to a pad. This allows some flexibility in the lead to absorb vibrations and mechanical stress from the collimator. Strain relief was added to the 25 pin D- connector.

LED Cover

The early style did not have one. Problems occurred when planchets, not properly installed would contact the infrared diodes and pull them loose from circuit board. An LED cover, which prevents this from occurring, can be installed on all early versions of changers.

Slide Rails

The early style was manufactured from brass. Subsequent styles used Teflon-coated steel rails. Both types were more susceptible to galling and had to be cleaned and lubricated frequently. The new style consists of a steel rail hot-dipped in liquid nylon. A smooth and durable surface is obtained, exhibiting minimum friction between slide and support rails. This also requires a new T block due to difference in dimensions.

Sample Slide

The early style was manufactured from nickel-plated steel with lead shielding attached with 10-32 socket-head screws. A problem occurred when the screws were over-tightened. Screws could be tightened through the lead shield entirely. The screws would then protrude through the bottom of the slide into the slide support rail. This resulted in excessive wear of the rails, and elevated the slide from its correct orientation with the detector drawer, causing jamming of the slide. The new assembly is still a nickel-plated steel slide, but the lead has been changed to nickel-plated copper. Also, the large shield has slotted holes to allow for minor adjustment of the channel for smooth carrier movement.

Slide Indexing Bar

The early style was an aluminum bar with notches cut into it to allow indexing of slide photo sensors. The problem with the early-style changers is the minor dimensional variation between the changers. These variations cause the mechanical action of the slide to differ from the designed tolerance of the slot width in the indexing bar (that is, slide in and slide out could not be adjusted accurately). A later style has an adjustable window width to allow for precise adjustment of slide in and slide out position. The present style has a fixed vane or magnet, mounted to the slide and a photo detector assembly or Hall-effect sensor mounted to each end plate. Tolerances are taken care of through software overdrive.

One Hundred Sample Option (High Torque Motor)

The early systems used 65:1 ratio motor, which worked well with 1/8 inch deep planchets. Deeper planchets added more weight than the motor could handle. Motors did not fail, but current load caused frequent shutdown through over-current protection. The new motor has 127:1 ratio with plenty of torque to handle more than 100 samples. THIS IS NOT RECOMMENDED FOR UPGRADE ON OLDER CHANGERS. Too many other problems are encountered unless additional upgrades are incorporated, such as:

Gear Trains

The system originally used plastic gears, which were then upgraded at no charge to customer. The early-style gears were retained on a shaft with 5/64 inch roll pins. They were 1/8 inch thick. In some locations, it was necessary to pin two gears together. This style of gears works well unless upgrading to the 3500-0003 motor (127:1 ratio). The cotter pin holes are slightly larger than pins. Reversing torque over a time will fatigue pins and cause them to shear. The new-style gears have smaller holes and result in gears being pinned tight to shaft. Also, spiral pins were incorporated in place of roll pins for added strength. Instead of pinning two gears together to obtain width of gear cogs, wide face gears have been incorporated.

Helixes or Crossfeed Cams

Those of the previous style are similar to the new style. The difference is that the new style has been cut down to allow use with the new mounting bracket for the inside rail of the mast assembly. This allows the carriers to be controlled during their entire descent to the helixes and eliminates any type of jamming problem related to displacement in the horizontal plane of travel.

14. Gas System

Gas Management

Most Tennelec Low Background Counting Systems include a gas regulator. Due to the differences in gas handling requirements in foreign countries, the gas regulator can be supplied locally as an option to meet the specific requirements. The gas regulator for the Series 5 is a single stage regulator. Tennelec counting systems, that are not equipped with Gas Stat or Gas Mode, require a dual stage gas regulator.

Gas control on the new Series 5 is managed using two modes of operation. Both modes incorporate digital flow control and sensing to provide the operator a precise read-out. Gas Mode, a standard feature of the Series 5 HP, controls the gas flow rate only. You can adjust the gas flow rate Eclipse LB. The gas flow rate is updated prior to each sample count. At no time during a sample count do changes in the gas flow rate take effect. Using the system status tab in the TAB Control View of Eclipse LB the operator can view the current flow rate.

Another mode of the gas management system incorporates a more sophisticated sensing system that continuously monitors and controls the gas flow rate. Gas Stat mode of operation is a standard feature of the Series 5 XLB. It can be equipped as an option on the Series 5 HP. Gas Stat provides the operator with the capability to control the gas flow for time and rate.

Note The secondary gas pressure should be set to 10 PSI ± 1 for normal operation. On systems that are equipped with Gas Stat or Gas Mode the inlet pressure to the system must not exceed 15 PSI for any reason. High pressures could cause irreparable damage to the detector window.

Gas Specifications

P-10 gas (90% Argon, 10% Methane) is recommended to be used in the Tennelec Series 5. The maximum operating high voltage for Tennelec counting systems is 1650 V.

Gas Mode

All Tennelec Series 5 systems use Automatic Gas Flow (AGF) regulation. A microprocessor based unit continuously monitors and maintains the operator-set gas-flow rate for consistent operation. AGF may reduce cost and down time due to window damage because it is virtually impossible to damage a window by over pressurization.

AGF may also increase stability in count results because internal gas pressure, which could affect the quality of counting data, is automatically held within tighter tolerances than possible with traditional manual controlled flow meters.

The gas system of the new Series 5 uses Standard Cubic Centimeters per Minute (SCCM). The conversion between Standard Cubic Feet per Hour (SCFH) is given by:

1 SCFH ≈ 470 SCCM.

For many applications, the factory default gas-flow rate will never need to be changed. Changing the gas flow rate is simple and fast through Eclipse LB software. Care should be taken when changing the flow rate from the factory default. Flow rate affects spillover dramatically and has a small effect on Background and Efficiency. If it is necessary to change the gas flow rate, the system performance should be re-selected. Re-calibration may be necessary after changing the flow rate.

To access gas mode setup, select **System | Gas Flow Setup** from the main menu. A more detailed system operation can be found in the next section.

Gas Stat Gas Conservation System

The Series 5 with Gas Stat sets a new standard in the industry for eliminating the need for frequent re-calibrations due to counting gas changes.

Gas Stat senses when the system is not counting samples, and automatically reduces the gas flow rate to a low quiescent flow to maintain detector gas quality. This prevents atmospheric impurities from diffusing into the detector and causing questionable results. The system is microprocessor controlled and provides unattended operation. The operator can modify gas Stat settings.

This unique development effectively increases the useful life of the gas supply thereby reducing the frequency of instrument re-verification, saving time and improving the quality of counting data.

There are four different modes in which Gas Stat can be operated: Maximum, Normal, Minimum, and Custom. The parameters are:

Operate Flow - The normal operating flow rate.

Inactivity Time - The amount of time the system will be idle before it goes into standby.

Standby Flow - The flow rate while the system is in standby.

Purge Flow - The flow rate at which the system will purge when inactivity has ended prior to settling and then counting.

Purge Time - The time the Purge Flow will last before the settling starts.

Settle Time - The time the system will wait after purge before a count commences. This allows pressure equalization.

To activate Gas Stat setup screen, select **System | Gas Flow Setup** from the main menu.

Maximum

This is for the lowest gas usage. The parameters are:

Operate Flow:	25 sccm
Inactivity Time:	30 minutes
Standby Flow:	10 sccm
Purge Flow:	100 sccm
Purge Time	0.5 minutes
Settle Time:	0.5 Minute

Normal

This is for moderate gas savings. The parameters are:

Operate Flow:	50 sccm
Inactivity Time:	30 minutes
Standby Flow:	25 sccm
Purge Flow:	100 sccm
Purge Time:	0.5 minutes
Settle Time:	0.5 Minute

Minimum

For the least gas savings, but the system should be available to count almost immediately.

Operate Flow:	50 sccm
Inactivity Time:	30 minutes
Standby Flow:	40 sccm
Purge Flow:	100 sccm
Purge Time:	0.5 minutes
Settle Time:	0.5 Minute

Custom

The user can specify the individual parameters.

Gas Operational Modes and Front Panel Displays

Gas Off/HV Disable

The Gas Off/HV Disable mode interrupts the flow of gas to the detectors and disables (turns off) the detectors high voltage. The Gas Off/HV Disable mode is entered either by the detection of low gas pressure or through software control.

The *red* Gas Off/HV Disable front panel indicator signifies that the system gas flow and high voltage are in the OFF state. The OFF state is entered either by the detection of low gas pressure or through software control.

Standby

The Standby mode reduces the normal gas flow rate (~50 SCCM) to a level that maintains a minimal gas flow rate (~10 SCCM) through the detectors. When the gas conservation feature is active, the Standby mode (gas conservation) is entered after a period of system inactivity. The inactivity period default is 30 minutes, but can be modified through software control. The standby flow rate default is 10 SCCM, but can be modified through software control.

The *yellow* Standby indicator signifies that the system is in the gas conservation mode. When the gas conservation feature is active, the Standby mode (gas conservation) is entered after a period of system inactivity and normal system gas flow is reduced to a minimal standby flow rate.

Standby mode is only present on systems equipped with Gas Stat.

Purge

When the gas conservation feature is active and the system in the Stanby mode, the Purge mode is entered before normal sample counting is resumed. The Purge mode increases the gas flow rate to a high level (~100 SCCM). This operation ensures that any gases or water molecules that might have diffused into the detectors during standby are purged from the system before resuming normal counting. The purge flow rate default is 100 SCCM, but can be modified through software control. The purge time default is 1 minute, but can be modified through software control.

The *flashing yellow* Purge indicator signifies that the system is in the gas purge mode. When the gas conservation feature is active and the system is in the Standby mode, the Purge mode is entered before normal sample counting is resumed.

Purge is only present on system equipped with Gas Stat.

Operate

This is the normal operational mode of the system. The Operate mode can be entered manually (custom settings) or as the normal counting mode when the gas conservation feature is active. When the gas conservation feature is active and a purge cycle has ended, the system will enter normal operation after a delay to ensure that the operational gas flow rate has stabilized. The operational delay default is 0.5 minutes, but can be modified through software control. The normal operational flow rate is 50 SCCM, but can be modified through software control.

The *green* Operate indicator signifies that the system is in the normal operational mode.

15. Counting with Gas-Flow Proportional Detectors

Proportional Counting

Gas-flow proportional counting is recognized as one of the most practical methods for performing gross alpha and/or beta measurements. Measuring the gross radioactivity in a sample provides a simple direct method of sample screening. Most of the natural and manmade radio-nuclides of interest decay by alpha emission or beta decay. Their detection in the proportional counter can be correlated to the number of atoms decaying in the sample per unit time that is, by definition, the activity.

There are many significant advantages to using a gas-flow proportional system for gross quantitative measurements. The selection of this technique is often related to the types of samples to be measured. Considerations of sample preparation, sample size, desired detection limit, and post-process wastes are also significant issues underlying the choice of the counting method. Tennelec LB systems are capable of providing accurate radioactivity measurements, at and below naturally occurring levels, for a wide variety of sample types.

	Gas-flow proportional systems
Advantages	Well suited for solid samples including smears, air filters, filtrate, evaporate, precipitates, electro-deposition, and unprocessed samples. Good detection efficiency (near 2π). Simple sample preparation. Low background count rate (0.85 beta, 0.1 alpha). Automated acquisition and analysis. Multiple detector systems for high throughput available. Simultaneous alpha and beta measurement. Pancake detector geometry provides consistent counting geometry. Active shielding reduces cosmic and ambient background count rate. Does not require efficiency-quench correlation.
Disadvantages	Liquid samples must be evaporated or precipitated. Attenuation in thick solids must be corrected. Quantitative radio-nuclide analysis requires radiochemistry.

The remainder of this section presents introductory technical discussions on how gas detectors work (refer to “How a Gas Detector Works” on page 198), how proportional gas detectors work (refer to “Proportional Detectors” on page 200), a discussion of the various counting modes (refer to “Discussion of Count Modes” on page 203), issues relating to the operation of such detectors, and to measurements performed with them (refer to “Factors Affecting Sample Measurements” on page 205).

How a Gas Detector Works

A gas-flow proportional detector is a type of gas-filled detector. It consists of a volume of gas surrounded by a housing called the detector body. The detector can be sealed or in the case of the counting systems, designed to allow a continuous flow of counting gas. A voltage is applied across the electrodes within the detector creating an electric field. When radiation from the sample is emitted and passes though the detector gas, it can ionize the gas molecules to form electron-ion pairs.

Ionization and excitation are the principle interactions of energy transfer between charged particle radiation and matter, including the matter that makes a detector. The moving charged particle exerts coulombic (electromagnetic) forces on atomic electrons and imparts energy to them. Energy loss interactions with the nucleus are negligible except for particles at low velocities. If the particle-electron interaction transfers sufficient energy, an electron bound to the atom can be freed (the binding energy is exceeded), freeing it from its bond and thereby ionizing the atom. Alternatively, the atom can be left in an excited but non-ionized state.

Energy and angular momentum conservation laws maintain that the maximum energy transferred in a single collision is usually a small fraction of the charged particle’s energy. Therefore a heavy charged particle such an alpha particle travels nearly a straight path through matter, losing energy almost continuously in small collisions with atomic electrons. Occasionally, large angle deflections can occur to alpha and other charged particles resulting from Rutherford backscattering and other effects.

Beta particles, including electrons and positrons, also lose energy almost continuously as they traverse through matter. However, unlike heavier charged particles, their mass is about equal to that of the atomic electrons with which they are interacting. They can lose a large fraction of their energy in a single collision. They are also deflected at large angles by collisions with nuclei. As a result, the path of betas through matter is rarely straight. Other processes, such as bremsstrahlung that result from a deflection of an electron by a nucleus also result from interactions of betas with matter.

Gas detectors such as those used in Tennelec LB systems utilize the ionization processes for radiation detection. For most gases, including P10 argon/methane, the average energy to create an electron-ion pair is about 30 eV. This value accounts for all collisions, including those that lead to excitation. For a 3 MeV alpha or beta particle that deposits all of its energy in a detector, the number of electron-ion pairs produced by only primary ionization, will on average be:

$$\frac{3\times10^{6}\ \text{eV}}{30\ \text{eV / pair}} = 10^{5}\ \text{electron} - \text{ion pairs}$$

This calculation is valid for only the primary ionization produced from the radiation. It excludes the effects of gas multiplication and secondary ionization that occur in proportional and Geiger-Müeller operating regions, discussed below. Furthermore, a typical gas detector that has a capacitance of about 50 pF (picoFarads) with charge collection in the range of 1 μs. Assuming all of the charge from this primary ionization is collected from the 3 MeV particle, it will produce a voltage and current of:

$$V = \frac{Q}{C} \approx \frac{10^{5}\times1.6\times10^{19}\ \text{C / e}}{50\times10^{-12}\,\text{F}} \approx 0.5\times10^{-3}\,\text{V} \approx 0.5\text{mV}$$

where

V = output voltage from the detector

mV = milliVolt = 1/1000 V

Q = total charge collected = number of charges collected times the charge in Coulombs per electron

C = capacitance of the detector in Farads

$$i = \frac{Q}{t} \approx \frac{10^{5}\times1.6\times10^{9}}{10^{-6}}\ \text{A} \approx 1.610^{-8}\ \text{A}$$

where

I = current in amperes output by the detector

Q = total charge collected

t = collection time of charges (pulse processing shaping time)

Operating Regions of Gas Detectors

Gas detectors operate in different ways depending upon the electric field strength, a function of the operating voltage applied to the electrodes. The classic discussion describes five operating regions, recombination, ionization, proportional, Geiger-Müller (GM region), and continuous discharge.

Recombination Region

In the recombination region, the electrons and ions move slowly and can recombine before they reach the electrodes. Increases in high voltage result in a stronger electric field that collects more ions and /or electrons as recombination increases.

Ionization Region

No additional charge is collected with higher voltages because no recombination is occurring and no additional charge is created by secondary ionization.

Proportional Region

Above a certain voltage, there is enough energy in the electric field to cause secondary ionization from the electrons produced from the radiation's primary interactions. Further increase in high voltage results in more charge being created and collected. The gas multiplication factor is a measure of this secondary ionization and is defined as the ratio of total ionization produced divided by the primary ionization. This factor is, for a given voltage, independent of the primary ionization event energy. Therefore the output pulse maintains proportionally, its amplitude relative to the primary ionization event energy. As a result, particle identification and energy measurement are possible.

Geiger-Müller (GM) Region

As voltages are further increased, the electric field is so strong that an ionizing event ionizes all the gas molecules in the volume of the detector. This avalanche produces a large signal with shape and amplitude independent of the original ionizing event's energy.

Continuous Discharge Region

Above a critical voltage, a single ionizing event starts a continuous discharge in the gas. There is no recovery and the device no longer functions as a counter and may even be damaged.

Proportional Detectors

Most commercial detectors, including the Tennelec gas-flow proportional detectors, are designed to operate in only one of these regions. Proportional counters operate in the region where gas multiplication takes place and where the output signal is proportional to the energy deposited by the radiation. For charged particles such as alpha and beta particles, the signal pulse is produced for every particle that deposits a significant amount of energy in the gas.

Gas Multiplication in Proportional Detectors

Gas multiplication occurs when secondary ionization occurs between the primary ionized electrons and neutral gas atoms. Most gas multiplication occurs where the electric field strength is high, near the anode wire as the electrons are accelerated. The production of this shower of electron-ion pairs is called a Townsend avalanche.

In addition to secondary ionization, secondary excitation can occur. Those events resulting in excitation without creation of a secondary electron are lost to the detection process. Occasionally, their decay by emission UV or visible light can produce additional secondary ionization of a less tightly bound electron in another gas molecule as described in “Gas Composition and Quenching” on page 205. When this occurs, spurious signals may result. This additional ionization can result in spurious pulses because of the time differences in when the charge is collected.

Therefore, the detector is operated at lower gas multiplication factors in order to limit the amplitude of the voltage output pulses to only those events that deposit more than a minimum limit of energy. These pulses create enough electron-ion pairs to produce an output voltage large enough to exceed the lower noise discriminator of the counter. However, the pulses are not so large as to create single avalanches that introduce nonlinearity for large pulses and spurious background counts from noise.

Relationship of Plateau Voltage to Charge Collection

Operation of a proportional counter involves the selection of operating voltage within the operating region, in this case the proportional region. Within the proportional region, the relationship between the applied voltage and the collection of charge, results in regions where increases in voltage do not result in increasing countrate. This region is called a plateau. A voltage plateau is a required part of instrument setup. The shape of the voltage plateau will vary depending upon the radio-nuclide and its associated nuclear decay scheme. To generate a voltage plateau, a check source containing a single alpha or beta emitting radio-nuclide is counted as the detector voltage is varied. An operating point is selected that corresponds to a flat region on the a plot of count rate versus operating voltage.

Alpha Particle Interactions with Proportional Detectors

If a source is mono-energetic and the radiation deposits all of its energy within the detector, a proportional counter records each particle that enters its active volume with nearly 100% efficiency. This is usually the case for alpha particles emitted from a specific nuclide. However, with a pancake geometry, such as that used in the Tennelec LB systems, the detector thickness is about 0.375 in. which is less than the range of an alpha particle in air. Ignoring small differences in density between ^{10}P and air, the gas pressure is at atmosphere, so some alpha particles may reach the back wall of the detector. Nevertheless, the alpha particles deposit most of their energy in the gas and therefore create a large output pulse.

Even considering the energy range of most alpha particles is between 4 and 8 MeV, the detector dimensions are large compared to the range of the alpha radiation. As a result, alpha particles deposit nearly all of their energy into the detector creating abundant electron-ion pairs within a short range. Energy loss does occur in both the window and air between the sample and the detector. Absolute measurement of alpha radioactivity is simple if one knows the geometric efficiency and can correct for self-absorption and scattering in the source. Self-absorption and sample scattering are discussed in “Sample Self-absorption and Scattering” on page 209.

Beta Particle Interactions with Proportional Detectors

Beta particles have ranges that greatly exceed the dimensions of a typical proportional detector. The number of electron-ion pairs produced is proportional to only that part of the energy deposited in the gas before the particle reaches the back wall. (Note that some backscatter can occur from the detector’s back wall, but the creation of additional charge pairs will occur within the same collection time as those produced from the original radiation track and will be recorded as a single event of greater amplitude. Backscatter can also occur within the sample for higher energy beta particles. These can contribute to measured efficiencies greater than expected from geometrical considerations alone.)

As a result of the weaker primary ionization of the gas by the beta particles, the output pulses are much smaller than those resulting from alpha particles of equivalent energy are. Beta decay also results in lower energies (1-4 MeV) than most alpha decays (4-8 MeV), although some overlap in their energy ranges does exist. Furthermore, in beta decay, the beta particle shares its energy with a neutrino and hence, can itself have an energy from 0 to a maximum energy equal to the energy difference of the two ground states.

Operating Voltage In Relation To The Type Of Radiation

Within the proportional region, the operating voltage is set to a plateau where the count rate does not increase significantly as a function of applied voltage. As voltage is increased within the region, an alpha plateau is reached first because the alpha particles create sufficient charge in the gas that the gas multiplication factor is sufficient to result in an output pulse that exceeds the lower discriminator. The alpha plateau is relatively flat; with ^{210}Po, it remains flat over hundreds of volts.

As the voltage is further increased, the gas multiplication factor also increases. Eventually, the smaller charge produced in the detector gas by primary ionization of the beta particles is multiplied sufficiently that the beta output pulses also exceed the threshold. At this point, the alpha pulses are even larger due to the higher gas multiplication factor. The plateau for a beta emitting radio-nuclide is shorter and may have a steeper slope than an alpha plateau, often flat or slightly increasing over a 200 volt range. At the beta plateau voltage, both alpha and beta particles create enough charge pairs and hence output pulse amplitude that they are both counted.

Simultaneous Alpha and Beta Measurements

Theoretically, an alpha or beta particle of the same energy that deposits all of its energy in the detector will produce identical numbers of primary-ionization electron-ion pairs and hence equivalent output pulse voltages. Practically, this is not observed, but rather the alpha and beta particles have different pulse heights for equivalent energy particles. First, there is a difference in the energy range of alphas and betas. Second, the difference in the interaction processes of alpha and beta particles with matter result in vastly different ranges and interaction probabilities for each particle. Both of these factors contribute to generally smaller beta output pulses and larger alpha output pulses.

Two methods of differentiating alpha and beta pulses have been employed in LB counting systems. The first, pulse height discrimination utilizes the difference in the amplitude of the output voltage pulses created from each type of radiation. The second method uses pulse shape discrimination that is based upon the differences in collection time of charges from each type of radiation. The Tennelec LB systems use pulse height discrimination, a measure of the pulse's voltage created from the interaction of radiation in the detector, to differentiate alpha from beta pulses.

By examining the amount of charge produced in the detector and by recognizing the differences of how alpha and beta particles interact in the detector, it is possible to distinguish between the alpha and beta radiation. Differences between the alpha versus beta particles are measured by examining the output pulse height of each. By setting not only a lower discriminator but a lower and upper discriminator for the beta and alpha windows, an energy range, ΔE, that corresponds to an output pulse voltage range, ΔV, for each type of radiation may be defined. When a pulse falls into the beta energy range, a counter for the beta channel is incremented by one. Similarly, a counter for the alpha energy range is incremented when the particle's output pulse falls in this voltage range. In this way, the sample's alpha and beta activities may be determined simultaneously.

Discussion of Count Modes

Eclipse-LB software provides for three different counting modes that address many counting applications. Simultaneous counting of alpha and beta radiation provides maximum throughput but adds some uncertainty and inaccuracy because of spillover effects. Alpha then Beta count mode provides better accuracy and lower uncertainty but requires each sample be counted twice. Alpha Only count mode is perfect for alpha measurements when no beta measurement is required.

Alpha Only

The Alpha Only count mode is ideal for counting applications that require only an alpha result. There are many advantages including:

- Lower overall background
- No beta to alpha spillover
- No alpha and beta discriminators to modify
- Simple counting parameters
- Only alpha plateau needed

Alpha Only optimum voltage plateau is typically achieved with a Tennelec gas flow detector (using P-10 gas) between 300 and 900 volts.

Alpha then Beta

The Alpha then Beta mode is an automatic means to count the sample first at the optimum alpha voltage plateau and then for a second count at the beta (plus alpha) optimum voltage plateau setting. This allows the beta counts to be determined as the difference between the two measurements. At the beta plateau voltage, both alpha and beta pulses are counted, the beta activity is determined by subtracting the counts recorded at the alpha plateau voltage from the combined counts measured at the beta voltage. Essentially Alpha then Beta count mode is Alpha Only then Alpha/Beta Simultaneous minus Alpha. The advantages to using Alpha Then beta are:

- No need to set alpha and beta discriminators
- No spillover from alpha into beta and beta and into alpha

The disadvantages include:

- Need to count each sample twice, once at each plateau voltage
- Lower throughput that simultaneous mode
- Statistical problems associated with counting samples multiple times under different conditions
- Must run both alpha and beta plateaus

The typical alpha operating voltage is 300-900 volts. The typical beta operating voltage is 1350-1590 volt.

Simultaneous (Alpha and Beta)

The most efficient count mode for measuring both alpha and beta radiation is the simultaneous counting mode. Counting is performed at the beta (simultaneous) plateau voltage. Simultaneous mode uses pulse height discrimination to differentiate between alphas and betas.

The advantages of counting in simultaneous mode are:

- Only need to count sample once
- Measure both alpha and beta activity at the same time

The disadvantages are:

- Must set Discriminators to match gas, high voltage, and radio-nuclide
- Must only have Beta plateau but Alpha is highly recommended
- Spillover a) alpha into beta and b) beta and into alpha

The typical Simultaneous operating voltage at sea level is 1350-1590 volts using a $^{90}Sr/^{90}Y$ point source in a 2 in. x 1/8 in. deep stainless steel insert. This operating voltage can decrease with an increase in elevation.

Factors Affecting Sample Measurements

There are several factors that can directly affect the quality of results using a gas flow proportional counter. Following some of the most common factors causing interference in GFPC’s.

Gas Composition and Quenching

While many gases work in an ionization detector, this is not true for proportional detectors. The quality and composition of the counting gas has a direct effect on the performance of the counter. In proportional detectors, the output signal is derived from the collection of free electrons. Any creation of negative ions competes with free electron production and collection; therefore affects the proportionality of the output pulses. The fill gas must not contain any molecular gas components that are strong electron attractors that form anions. The noble gases are ideal for proportional detectors.

Another consideration in the selection of the counting gas for proportional detectors is that secondary Townsend avalanches are infrequent. These secondary avalanches result when ultraviolet photons produced by atomic de-excitation occurs in the gas. The addition of a quenching agent, usually a polyatomic gas such as methane that is added to the argon gas, suppresses further ionization from excited gas atoms. The quenching agent absorbs the UV photons and then de-excites by dissociation or radioactive modes of de-excitation that do not result in localized ionization avalanches in the gas. As discussed above, when these secondary avalanches do occur, they may result in higher background or spurious counts in the detector. The most commonly used counting gas, P-10, utilizes this principle in its 90% argon 10% methane mixture.

Gas Quality

The composition of the gas can vary among suppliers and occasionally from different bottles from the same supplier. Chemical impurity in the gas such as water vapor may be present. These impurities can cause a quenching effect that will affect the background count rate and the measured efficiencies of the counting system. Calibration plateau, background and efficiency should be verified whenever the gas is changed.

Sources of Background in Gas Proportional Detectors

Cosmic radiation and natural radiation in the environment both contribute to the observed background of gas proportional counting systems. The most important of these include:

- Natural radioactivity in the detector materials.
- Natural radioactivity in associated equipment, supports, shielding, and circuitry near the detector.
- Radiation from other materials in the laboratory including walls, building, and subsurface materials.
- Radioactivity in the gas or air near the detector (radon and thoron daughters).
- Cosmic radiation.

Instrument Methods to Reduce System Background

Voltage Discrimination

The counting gas is not as sensitive to fast electrons as it is to alphas and heavily charged particles; therefore, operating the detector at the alpha plateau voltage results in beta output pulses that do not exceed the counting voltage threshold. Under these conditions, many possible sources of background are eliminated. The observed background in a proportional detector is a function of the threshold setting that defines the minimum ionization required for a count to be recorded.

Active Methods - Anti-Coincidence Background Reduction

Modern Tennelec LB systems employ active anti-coincidence to further reduce the background count rate due to external cosmic interactions with the sample detector. The guard detector and sample detector are similar in that they are both gas-flow proportional detectors, but each has been optimized. The guard detector does not have a thin mylar window. It has a thick metal plate on both sides that maximizes the interaction of cosmic rays and gamma rays with the gas.

When the pulse processing electronics sense a suitable event in the guard detector, the linear gate of the sample processing electronics is enabled. This disables the sample counter and timing electronics for a predefined time. This type of gating in the electronics is called anti-coincidence gating because the sample counters are turned off when an event is coincident in both detectors. This suppression assures no spurious counts will occur in the sample detector as a result of a cosmic ray shower or other ambient background source. The result is lower background count rates, <1cpm, versus 20 cpm in a system without active anti-coincidence. The guard detector is most effective for rejection of gamma ray, which could be counted as betas.

Passive Methods - Shielding

The passive lead shielding effectively blocks all alpha and most beta radiation from reaching the detector unless it originates in the sample. Passive shielding is less effective for electromagnetic radiation such as cosmic rays and gamma rays. For these types of radiation, the active shielding provides additional background reduction.

Tennelec Series 5 systems provide a choice of passive shielding thickness. When weight or portability is not a concern, the lowest background performance is obtained with the 4 in. shielding. All materials used in Tennelec LB systems are carefully evaluated and chosen based upon their content of radioactive constituents.

Spillover Effects

Spillover is the effect of an alpha particle being falsely registered as a beta count or vice versa (Figure 147). Spillover occurs due to the pulse height discrimination methods employed by GFPC's.

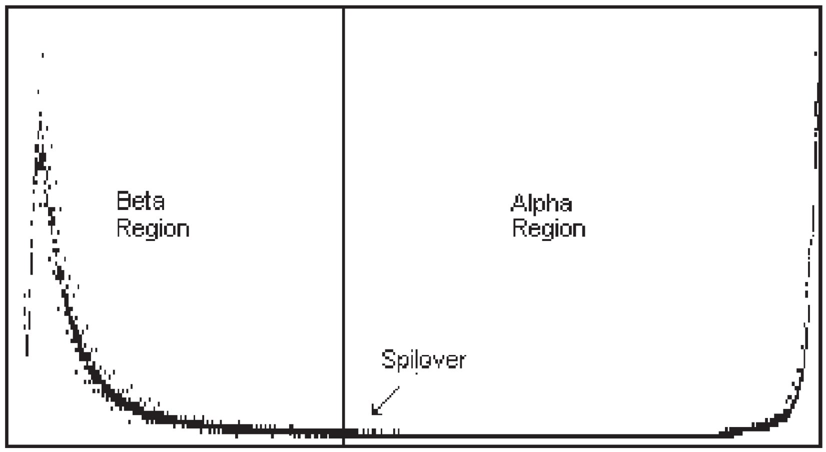


Figure 147 Example of Spectrum Source Showing the Spillover Region

Spillover results from either alpha particles depositing too little energy in the detector that is then recorded as a beta, or when more than one beta or a high energy beta deposits sufficient energy in the detector to be recorded as an alpha count. The effects are dependent upon the settings of the various lower and upper level discriminators for each energy range that defines a region of interest for betas and alphas.

For samples containing a single radio-nuclide that decays by only alpha or only beta, discriminator settings can be applied that make spillover negligible. However, for some radio-nuclides that decay by both alpha and beta and for decay series where daughter nuclides grow in, the sample may have a significantly different spillover ratio than the calibration source. Mixed sources are not optimal for calibration of efficiency and spillover effects. When the samples and efficiency source have dissimilar compositions, the spillover correction can introduce a significant error. When this situation is suspected, it can be verified by counting the samples using the Alpha then Beta counting mode.

Spillover can be avoided by using the alpha only or alpha then beta counting modes. Nevertheless, when throughput is an issue, simultaneous counting is effective and spillover negligible for many counting applications.

Region Discrimination to Minimize Spillover

The Tennelec Series 5 has two discriminators rather than one. The Beta Upper Level and the Alpha Lower Level can be operated at the same level to simulate systems that have only the Alpha Discriminator. However, when maximum spillover rejection is desired a deadband can be established between the BUL and the ALL (Figure 148). This may result in slightly lower overall efficiency, but can decrease spillover tremendously. When calibrating a GFPC, it is important to determine radio-nuclide specific regions of interest. Multiple calibrations may be necessary to satisfy each application.

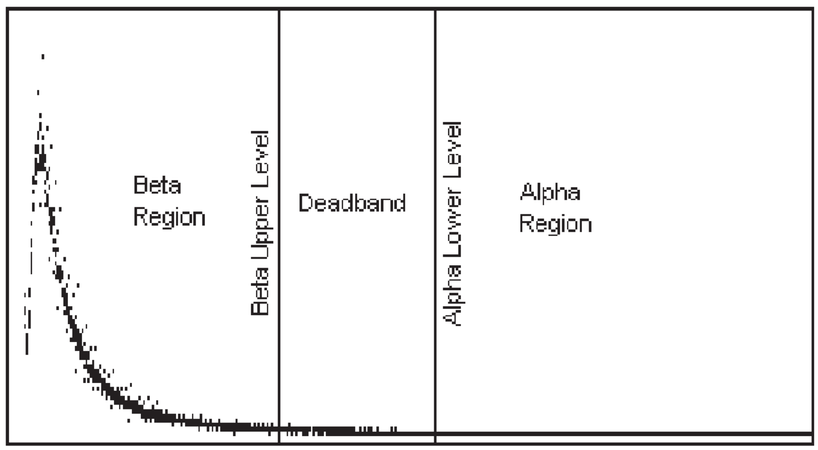


Figure 148 Spectrum of a Pure Beta Emitter Using Two Alpha-Beta Discriminators

Sample Self-absorption and Scattering

Charged particles interact with the air and intervening detector materials and can result in energy loss by the particles. Only the energy deposited into the detector is useful for the measurement. These charged particles can also interact with other atoms in the sample itself. Both self-absorption and scattering may result that can affect the calibration and/or measurement of an unknown sample. Self-absorption is significant in higher density samples such as high-Z materials, but cannot be neglected in soils and even liquids for alpha particles of any energy and for low energy beta particles such as ^{3}H and ^{14}C.

Detector Geometry

Gas detectors have been manufactured in different sizes and shapes. The optimum design is the pancake style. The Tennelec Series 5 utilizes a pancake detector that provides a flat entrance window, convenient for most sample counting geometry's. The detector shape determines the electric field strength and variations within the detector. The pancake geometry ensures uniform electrical field distribution throughout the active volume of the detector for uniform charge collection.

Gamma and X-ray Sensitivity of Proportional Detectors

Gas-filled detectors operating in the proportional region are sensitive to X-rays and gamma rays below 100 keV. Above this energy, the intrinsic efficiency drops off rapidly because most of the measurable pulses result from photoelectric interactions. Photoelectric processes are a strong function of both Z, the atomic number of the material, and E, the energy of the radiation. Photoelectric absorption follows atomic number as Z^5 and is inversely proportional to energy as $1/E^{3.5}$. Nevertheless, X-rays and gamma rays emitted from a sample and those produced in secondary and tertiary cosmic ray production can interact in the detector and result in background counts or as spurious beta counts. The use of a cosmic guard detector reduces the cosmic ray contribution to background by a factor of 100. Associated X-rays and gamma rays from a given radionuclide can result in a beta plateau, which may have a different shape due to the additional contribution of alpha and beta events.

Quantitative Measurements with Gas-flow Proportional Counting Systems

Determining accurate analysis for specific radio-nuclides can be performed using chemical methods to isolate and purify the radio-nuclide(s) of interest. Conventional chemistry using ion-exchange resin or extraction solvents allows specific radiochemicals to be separated from one another. The physical separation of the radionuclides of interest from the sample matrix must be performed because the proportional counter cannot be easily used to resolve different alpha or beta emitters. Beta decay results in a range of energies that precludes energy spectroscopy for a proportional detector.

16. Troubleshooting

This chapter provides some troubleshooting techniques for your Tennelec Series 5Automatic Low Background Alpha/Beta Counting System.

System Status Indicator

During normal operation, the System Status indicator on the Series 5 front panel will be green. It can either be:

Green - Normal Operation.

Yellow - Gas Problem, see Gas Flow Problems.

Red - Power Supply Problem, see GAS OFF/HV DISABLE

Gas Flow Problems

The System Status Light is yellow for one of two reasons. The system will either interpret that there is no gas connected (Low Gas Condition) to the system or that output flow of the Electronic Gas Flow regulator does not match the set flow. Problems and common solutions are discussed. Please check each of these conditions before calling Canberra.

Gas Pressure Low

After changing the gas bottle, it is necessary to set the pressure on the secondary gas regulator to 10 psi ± 1 psi. The internal pressure switch in the Series 5 is factory preset to 5 PSI. Any setting of less than 5 psi will not activate this switch. No counting will commence until the pressure is above 5 psi.

Gas Tubing Crimped or Secondary of Regulator not Open

With the gas regulator turned on, disconnect the gas tubing from the system's rear panel GAS IN connection by simultaneously pushing in on the lip of the connector and pulling out the tubing. If gas is flowing, you should be able to hear and feel it. Return the tubing to the GAS IN connector.

Gas Not Flowing

If gas did not flow there may be an obstruction in the filter or the regulator may be damaged. Contact Canberra for replacement.

Gas Flowing

If gas is flowing, the gas flow regulator may be damaged or the pressure switch may be defective. Call Canberra for replacements.

Bubble Test

Verify that gas is flowing through the detector assembly by performing a bubble test. This is accomplished by submerging the exhaust gas line (located at the rear of the system) about one centimeter below the surface of a beaker of water or alcohol. On a gridded windowless system, a sample insert must be inside the detector chamber to accomplish this test. Absence of bubbles indicates a leak in the system, and usually is associated with a ruptured or punctured detector window. Failure here requires accessing the detector assembly.

Plateau Problems

Abnormal plateaus are usually caused by incorrect percentage of argon and methane in the gas mixture, the wrong gas in the cylinder, or contaminants, such as water or oxygen in the counting gas. Using filter paper type sources, sources that display some self absorption, a ruptured detector window, gas tubing, and detector leaks or electronics failure may also cause unusual plateaus.

Background Problems

High Background

If background measurements are not reproducible from one measurement to the next or are elevated, check the following:

1. Has the background count rate increased or decreased steadily or suddenly? If there has been a steady increase over the past few weeks or months, it is probably contamination. Some types of sudden electronic malfunction can also cause increased background rates.

2. Is the same carrier/insert always being counted? If not, try using the same carrier/insert all the time to see if the problem improves. If always using the same carrier, try replacing it with another and see if the background changes.

3. Does the problem appear when multiple counts are performed?

4. Has the x-talk increased or decreased substantially?

5. Has the system been re-calibrated (Plateau and ROI) since a gas bottle change?

6. Is it standard laboratory practice to clean the carrier/insert occasionally with alcohol or another decontamination agent? If no, periodically clean the carrier/insert. If yes, is there a correlation between when it is cleaned and when the background is elevated?

Efficiency/Spillover Problems

This section covers some common efficiency and spillover problems that can occur.

Sr-90 Efficiency too high

Many source manufacturer's do not account for the ^{90}Y in-growth in the ^{90}Sr standards. This results in the total activity of the standard actually being approximately 2x the stated value (and often an efficiency of 100% or greater). Because of its high energy, ^{90}Sr also has a back-scatter component that can make the efficiency greater than 50%.

Alpha Spillover too High

^{210}Po generally gives a spillover of $\leq$ 3% with the discriminators setup properly. This result is not attainable with other nuclides like ^{241}Am, ^{239}Pu, etc. The reason is that spillover is only one component that will be seen in the spillover channel.

The Tennelec Series 5 and all gas flow proportional counters (GFPC) report gross results. spillover correction should only be used to correct for the spill of alphas that are counted as betas and vice versa when using the alpha/beta (also called simultaneous) mode. This is accomplished by performing spill calibrations with ^{210}Po alpha and a pure beta emitter like ^{90}Sr/^{90}Y.

It is not valid to correct for spillover from daughter products that appear due to natural decay processes in a gross alpha/beta measurement. For example, let's say that we are counting Uranium 238.

Unless the ^{238}U has been recently separated, there will be substantial contribution from ^{234}Th (Beta Emitter), ^{234}U (Alpha Emitter), and so on through the Uranium decay chain. In the past, many people have tried to counteract these phenomena by performing spillover correction. First, let's define some terms.

Crosstalk is the contribution of additional counts from a source other than the intended source. Crosstalk is most significant when using a multi-detector system like the Tennelec LB4100-W. An example of crosstalk would be the contribution in detector one from a source located under detector two.

Spillover (or spill) has in the past been mislabeled crosstalk. It is the counts that are miscounted as another type of emission due to incomplete energy deposition, sample self absorption, etc.

Secondary Emissions have also been erroneously labeled as crosstalk. Secondary emissions can also be characterized as non-principal or minor emissions. ^{241}Am is regarded as an alpha emitter because of its principal emissions of 5.4 MeV Alphas. It also includes a 59.5 KeV gamma that is reported in a GFPC as beta. The result is ~25% (α to β) secondary emissions contribution in the beta channel.

Daughter Contribution has also been called crosstalk. It is due to natural decay processes that sometimes cause unexpected results.

The short-coming of the “spillover correction” method is that it over-simplifies nature. The correct terminology when using a GFPC is:

Twenty µciL of Alpha based on a ^{238}U calibration (correct)

not 20µciL of ^{238}U (incorrect)

The GFPC was never designed to perform radio-nuclide identification. It is a gross alpha/beta counter, not a spectrometer. The problem is the poor resolution of the Gas Flow detector. Although some emissions (like the Electron Capture of Fe55) give good resolution, most cannot be distinguished from other radio-nuclides. The GFPC is designed for, and is very proficient at identifying the quantity of emissions from a given radioactive source.

Count Timer Not Incrementing

The count timer not incrementing is usually caused by 100% dead time. Check the guard count rate (or the guard count LED on the amplifier. If it is glowing continuously, this is the problem. It can be caused by:

- Hardware Failure
- Moisture in the Gas
- Guard Threshold at zero

Data Reproducibility

There is uncertainty associated with any measurement. However, the Series 5 should be able to reproduce the results from a given standard consistently. If efficiency measurements are not reproducible from one measurement to the next, check the following:

1. Is the same standard being counted, or are there several standards that are being interchanged? Try using the same standard all the time to see if the problem improves.
2. Does the problem appear when multiple counts are performed? If not, it may be a geometry reproducibility problem. Try making a small orientation mark on the standard so it is always inserted in the same direction.
3. Has the spillover increased or decreased substantially?
4. Has the background count rate increased or decreased substantially?
5. Has the system been re-calibrated (Plateau and ROI) since a gas bottle change?

Report Generation Problems

Eclipse includes several reports pre-configured. If there is a problem viewing or printing a report, it could be caused by one of the following:

1. No printer driver selected in Windows.
2. No background in the database matching the geometry of the procedure selected which uses background subtraction.
3. No efficiency in the database matching the geometry of the procedure selected which uses efficiency correction.
4. Trying to Automatically print the report of an application that needs sample specific information entered.

Software Error Messages

This section covers common software errors.

Database Error Messages

Error Message: The eclipse database - eclipse.mdb - could not be located.

Cause: The database has been moved from the previous time Eclipse was run.

The database is read-only.

Solution: Use the provided open-file dialog box to open the database.

Use the Eclipse database properties sheet to un-check the read-only attribute.

Error Message: There are currently no valid devices on-line, try back when there are devices on-line.

Cause: A gas-con LB could not be found.

Solution: Make sure the device in the database is correct.

Make sure the device and host are communicating.

Divide by Zero Errors

Error Message: An attempt to divide by zero has occurred. The error occurred in the function CountRate.

Cause: This error is very unlikely. The culprit would be the firmware giving a live time of zero.

Solution: None.

Error Message: An attempt to divide by zero has occurred. The error occurred in the function NetCountRate.

Cause: The live time for the currently counting sample is zero. (Very unlikely.)

The background used to perform the background subtraction is zero. (Likely)

Solution: The background chosen by the user did not have the correct parameters for the current sample. Check the database to make sure the regions, geometry and detector match the current sample.

The live time for the chosen background is zero in the database.

Error Message: An attempt to divide by zero has occurred. The error occurred in the function Efficiency.

Cause: The activity of the standard is zero.

Solution: The incorrect standard was selected, that is, an alpha standard is used for a beta standard and visa-versa.

The database does not contain any standards.

Error Message: An attempt to divide by zero has occurred. The error occurred in the function Spillover.

Cause: The user is trying to perform a single point efficiency calibration and no counts have been detected.

Solution: Make sure there is a calibration source being counted.

Error Message: An attempt to divide by zero has occurred. The error occurred in the function Activity.

Cause: The efficiency is zero.

Solution: The efficiency chosen by the user did not have the correct parameters for the current sample. Check the database to make sure the regions, geometry and detector match the current sample.

Error Message: An attempt to divide by zero has occurred. The error occurred in the function Cd2.

Cause: The half-life is zero.

Solution: There is no half-life in the nuclide database for the selected nuclide.

Memory Errors

Error Message: Enough memory to perform a calculation could not be found. The error occurred in the function Singular Value Decomposition.

Cause: Out of memory.

Solution: Shut down other applications that might be running.

Buy more RAM.

Error Message: Enough memory to perform a calculation could not be found. The error occurred in the function nVector Allocation.

Cause: Out of memory.

Solution: Shut down other applications that might be running.

Buy more RAM.

Error Message: Enough memory to perform a calculation could not be found. The error occurred in the function dMatrix Allocation.

Cause: Out of memory.

Solution: Shut down other applications that might be running.

Buy more RAM.

Plateau Error Messages

Error Message: The selected device could not be found in the list of available devices.

Cause: The device hasn't been registered in the database.

Solution: Run the device registration utility.

Make sure the device in the database is correct, e.g., the device in the database can be address 1 when in fact it is at address 0.

Error Message: There is more than one current detector for the specified device; can't initialize.

Cause: The database contains two detectors for a single LB5100 device.

Solution: Remove one of the detectors from the database.

Assign the second detector to the correct device.

Error Message: There is no current plateau for this detector.

Cause: A plateau for the necessary count mode hasn't been run.

The latest plateau is not marked as "Is Current" in the database.

Solution: Run a plateau for desired count mode.

It is possible to mark the record "Is Current" but this isn't desirable.

Error Message: There are more than one current plateau for the specified detector.

Cause: There is more than one plateau record marked "current" for a given count mode.

Solution: It is possible to make one of the records that is marked "Is Current" not current.

A. References

1. Knoll, G.F., Radiation Detection and Measurement, Second Edition, John Wiley & Sons, 1989.

2. Tsoulfanidis, N., Measurement and Detection of Radiation, MacGraw Hill Publishing, 1983.

3. Parker, S.P., Nuclear and Particle Physics Source Book, MacGraw Hill Publishing, 1987

B. Glossary of Terms

Absorbers

(USAEC) Any material that absorbs or diminishes the intensity of ionizing radiation. Neutron absorbers, like boron, hafnium and cadmium are used in control rods for reactors. Concrete and steel absorbs gamma rays and neutrons in reactor shields. A thin sheet of paper or metal will absorb or attenuate alpha particles and all except the most energetic particles.

Absorption

The process by which radiation imparts some or all of its energy to any material through which it passes.

Absorption Curve

(ANSI N1.1-1976) A plot of an absorption radiation quantity (for example, energy flux density) as a function of the distance traversed in an absorber.

Abundance, Isotopic

(ANSI N1.1-1976) The relative number of atoms of a particular isotope in a mixture of the isotopes of an element, expressed as a fraction of all the atoms of the element.

Abundance, Natural

(ANSI N1.1-1976) Of a specified isotope of an element, the isotopic abundance in the element as found in nature.

Accredited Testing Laboratory

(ANSI N42.17A-1989) A testing laboratory that has been accredited by an authoritative body with respect to its qualifications to perform verification tests on the type of instruments covered by this standard.

Accuracy

(ANSI N42.13-1978) The accuracy, usually described in terms of overall uncertainty, is the estimate of the overall possible deviation from the “true” value. As used in this standard, the overall uncertainty is a total of the estimated errors plus the random error of the measurement.

Actinides

(HPJ 60-1991) The series of elements beginning with actinium, element number 89, and continuing through lawrencium element number 103, which together occupy one position in the periodic table. The series includes uranium, element number 92, and all man-made transuranic elements.

Actinium Series

(USAEC) The series of nuclides resulting from the radioactive decay of Uranium-235. Many man made nuclides decay into this sequence. The end product of this sequence if lead-207.

Active

Describes the window or icon to which the next keystroke or command will apply. If a window is active, its title bar changes color to differentiate it visually from other open windows. If an icon is active, the Control menu appears.

Activity

The number of nuclear transformations occurring in a given material per unit time.

Activity Concentration

(ANSI N13.14-1983) The quantity of radioactivity per unit volume or mass of a substance.

Activity Intake By Inhalation

(I_a) (ICRP 32-1981) "Activity intake" by inhalation is the inhaled activity of a radionuclide during a definite period of time.

Air Changes Per Hour (ACH)

(ENV RAD-1987) The number of air changes per hour in a building.

Air Dose

(NCRP 45-1975) (NCRP 94-1987) Absorbed dose in air is the quotient of the mean energy imparted by ionizing radiation to a volume element of air divided by the mass of air in that volume element. Air dose is expressed in rads. The air doses considered in these reports are essentially constant over distances that are large compared to the ranges of the charged particles producing the doses. Thus, the air dose is also a measure of the indirectly ionizing radiation field (primarily photon radiation) generating these charged particles.

Airborne Radioactivity

(ANSI N42.17B-1989) Radioactivity in any chemical or physical form that is dissolved, mixed, suspended or otherwise entrained in air.

ALARA

(NCRP 93-1987) A system of dose limitation based on keeping exposures, "as low as reasonably achievable," economic and social factors being taken into account.

Aliquot

(HPJ 60-1991) A divisor that divides a sample into a number of equal parts, leaving a remainder; a sample resulting from such a divisor.

Alpha Particle

A charged particle emitted from the nucleus of an atom. An alpha particle has a mass and charge equivalent to that of an ionized helium nucleus, consisting of two protons and two neutrons, with a double positive charge.

Ambient Background

(ANSI N42.12-1980) Those counts that can be observed, and thereby allowed for, by measuring a source that is identical to the unknown source in all respects except for the absence of radioactivity. These counts are attributable to environmental radioactivity in the detector itself, the detector shielding material, and the sample container; cosmic, electronic noise pulses, and so forth.

Amplification

As related to radiation detection instruments, the process (gas, electronic or both) by which ionization effects are magnified to a degree suitable for their measurement.

Amplifier, Linear

A pulse amplifier in which the output pulse is proportional to an input pulse height for a given pulse shape up to the point at which the amplifier overloads.

Analysis, Isotope Dilution

(RHH-1970) A method of chemical analysis for a component of a mixture, based on the addition to the mixture of a known amount of labeled component of known specific activity, followed by isolation of a quantity of the component and measurement of the specific activity of that sample.

Analyte

(ANSI N13.30-1989D) The particular radio-nuclide to be determined in a sample of interest.

Annihilation

(RHH-1970) (ANSI N1.1-1976) An interaction between a positive and a negative electron on which they both disappear; their energy, including rest energy, being converted into electromagnetic radiation (called annihilation radiation).

Annual Limit on Intake (ALI)

(NCRP 91-1987) The activity of a radio-nuclide that, taken into the body during the year, would provide a committed effective dose equivalent to a person, represented by Reference Man, equal to the annual occupational effective dose equivalent limit (HEL) or in some cases, the organ dose equivalent limit (nonstochastic effect). The ALI is normally expressed in becquerels (Bq) or curies.

Anode

Positive electrode; electrode to which negative ions and electrons are attracted.

ANSI

(RAH-1988) American National Standards Institute.

Application

A program in Windows used for a particular kind of work. For the Low-Background System, an application is a sample counting and analysis protocol.

Aqueous Tritium

(NCRP 62-1979) The tritium associated with water molecules.

Area (Workplace) Monitoring

(ICRU 43-1988) Monitoring intended to provide information about the radiation environment and about radiation conditions associated with the operations that are performed. Area monitoring also includes measurements made in the environment of the installation. The results of workplace monitoring are mainly used for categorizing and predicting radiation exposures. The objective of area monitoring is to establish that operational conditions are satisfactory; it is of only limited value in the estimation of dose equivalent to individuals.

Assay

(ANSI N42.12-1980) The determination of the activity of a radio-nuclide in a sample.

Atom

Smallest particle of an element that is capable of entering into a chemical reaction.

Atomic Mass

The mass of a neutral atom of a nuclide, usually expressed in "atomic mass units." The "atomic mass unit" is one-twelfth the mass of an atom of ^{12}C; equivalent to 1.6604 x 10^{-24} gram.

Atomic Number

The number of orbital electrons surrounding the nucleus of a neutral atom and according to present theory the number of protons in the nucleus (Symbol: Z).

Atomic Weight

(USAEC) The mass of an atom relative to other atoms. The present-day basis of the scale of atomic weight is carbon; the most common isotope of this element has arbitrarily been assigned an atomic weight of 12. The unit of the scale is 1/12 the weight of the carbon-12 atom or roughly the mass of one proton or one neutron. The atomic weight of any element is approximately equal to the total number of protons and neutrons in its nucleus.

Attenuation

The process by which radiation is reduced in intensity when passing through some material. It is the combination of absorption and scattering processes and leads to a decrease in flux density when projected through matter.

Attenuation Factor

A measure of the opacity of a layer of material for radiation traversing it; the ratio of the incident intensity to the transmitted intensity. It is equal to I_o/I, where I_o and I are the intensities of the incident and emergent radiation, respectively. In the usual sense of exponential absorption ($I = I_o e^{-mx}$) the attenuation factor is e-mx, where x is the thickness of the material, and m is the absorption coefficient.

Avalanche

The multiplicative process in which a single charged particle, accelerated by a strong electric field, produces additional charged particles through collision with neutral gas molecules.

Background, detector or system

The number of counts measured in an instrument when no sample is present. The background counts or count rate can be subtracted from the total or gross counts measured in a sample. The gross counts minus the background counts equals the net counts from the sample only.

Background Radiation

(NBS 73-1960) Radiation arising from radioactive material other than the one directly under consideration. Background radiation due to cosmic rays and natural radioactivity is always present. There may also be background radiation due to the presence of radioactive substances in other parts of the building, in the building material itself, and so forth.

Backscattering

The deflection of radiation by scattering processes through angles >90° with respect to the original direction of motion.

Bequerel (Bq)

(HPJ 60-1991) A unit of radioactivity equal to one radioactive disintegration per second.

Beta Particle

Charged particle emitted from the nucleus of an atom and having a mass and charge equal in magnitude to those of the electron.

Bias

(HPJ 60-1991) A systematic error inherent in a method of caused by some artifact or idiosyncrasy of the measurement system. Temperature effects and extraction inefficiencies are examples of this first kind. Blanks, contamination, mechanical losses, and calibration errors are examples of the latter kinds. Bias can be both positive and negative, and several kinds can exist concurrently, so net bias is all can be evaluated, except under special conditions.

Bioaccumulation Factor (BF)

(NCRP 76-1984) The ratio of a radio-nuclide concentration in an organism or tissue to that in water or food products.

Bioassay

(USAS N13.2-1969) Analysis of biological material to determine the presence and quantities of internally deposited radio-nuclides.

Biological Half-Life (Tb)

(NCRP 87-1987) (HPJ 60-1991) The time required for a biological system, such as a person, to eliminate by natural process, other than radioactive decay, one-half of the amount of a substance, such as a radio-nuclide that has entered it.

Blind Sample

(HPJ 60-1991) A sample submitted for analysis whose composition is known to the submitter but unknown to the analyst. A blind sample is one way to test proficiency of a measurement process.

Body Burden, Maximum Permissible

(ANSI N1.1-1976) The body burden of a radio-nuclide which, if maintained at a constant level, would produce the maximum permissible dose equivalent in the critical organ.

Branching Ratio

(ANSI N1.1-1976) The ratio of the branching fractions for two specified modes of disintegration.

Breathing Zone

(ANSI N13.1-1969) The breathing zone is identified as that region adjacent to a worker’s mouth and nostrils from which air is drawing into the lungs while he performs his assigned work. Air taken from this region will truly represent the air the worker is breathing while he works, whether standing, sitting or moving.

Bremsstrahlung

(AEC) Electromagnetic radiation emitted from (as photons) when a fast-moving charged particle (usually an electron) loses energy upon being accelerated and deflected by an electric field surrounding a positively charged nucleus. X rays produced in ordinary X-ray machines are bremsstrahlung (in German, the term means “braking radiation.”).

Calibrate

(ANSI N42.17A-1989) (ANSI N42.17B-1989) (ANSI N42.17C-1989) To adjust or determine or both: (1) the response or reading of an instrument relative to a series of conventionally true value; or (2) the strength of a radiation source relative to a standard or conventionally true value.

Capture, Electron

(RHH-1970) A mode of radioactive decay involving the capture of an orbital electron by its nucleus. Capture from a particular electron shell is designated as “K-electron capture,” “L-electron capture,” etc..

Carrier

(RHH-1970) (Beir III-1980) Nonradioactive or nonlabeled material of the same chemical composition as its corresponding radioactive or labeled material, so as to form a chemically inseparable mixture, the carrier permits chemical (and some physical) manipulations of the mixture with less loss of label or radioactivity than would be possible in the use of undiluted label or radioactive material.

Carrier, Hold-Back

(RHH-1970) The inactive isotope or isotopes of a radioactive element, or an element of similar properties or some reagent that may be used to diminish the amount of the radio-nuclide coprecipitated or absorbed in a chemical reaction.

Cascade

A way of arranging open windows on the desktop so that they overlap each other, with the title bar of each window remaining visible.

Cascading Menu

A menu that opens from a command on another menu.

Cathode

Negative electrode; electrode to which positive ions are attracted.

Chamber, Ionization

(RHH-1970) (BEIR III-1980) An instrument designed to measure quantity of ionizing radiation in terms of electric charge associated with ions produced within a defined volume.

Charged Particle

(NCRP 51-1977) An atomic or subatomic quantity of matter (for example, electron, proton, alpha particle, and ionized atom) possessing or lacking a net electrical charge of one or more alimentary units of charge.

Check Source

(ANSI N42.14-1978) (ANSI N323-1978) (ANSI N320-1979) (ANSI N42.12-1980) (ANSI N42.15-1980) A radioactive source, not necessarily calibrated, which is used to confirm the continuing satisfactory operation of an instrument.

Check Box

A small square box that appears in a dialog box and that can be selected or cleared. When the check box is selected, an X appears in the box. A check box represents an option that you can set.

Circuit, Anticoincidence

A circuit with two inputs which delivers an output pulse if one input terminal receives a pulse, but delivers no output pulse; if pulses are received by both input terminals within an assigned time interval.

Click

To press and release a mouse button quickly.

Close

To remove a document window or application window from the desktop. You can choose to save or abandon the document in a document window before you close the application.

Coincidence

The occurrence of counts in two of more detectors simultaneously or within an assigned time interval.

Contamination, Radioactive

Deposition of radioactive material in any place where it is not desired, particularly where its presence may be harmful.

Control Menu

The menu appearing on every application that runs in a window and on some non-Windows applications. Icons, some dialog boxes, and windows within an application workspace also have Control menus. For applications running in a Window and for icons and dialog boxes, Control-menu commands move, change the size of, and close windows. For non-Windows applications, the Control-menu commands transfer information and perform other miscellaneous functions. Also known as System menu.

Control-Menu Box

The icon that opens the Control menu for the window. It is always at the left of the title bar.

Controlled Area

(ANSI N43.1-1978) Any area to which access is controlled for purposes of radiation protection.

Cosmic Radiation

(ICRP 39-1983) Natural sources of radiation can be grouped in three types according to origin: Cosmic radiation, from the sun and from outer space, varies with altitude and latitude; Cosmogenic radio-nuclides (mainly caron-14), produced through interaction of cosmic rays with atoms in the atmosphere; and Primordial radio-nuclides, which have existed in the earth's crust throughout history (for example, potassium-49 and nuclides in the uranium and thorium decay series).

Cosmic Rays

High-energy particulates and electromagnetic radiation that originates outside the earth's atmosphere.

Cosmogenic Radionuclides

(ICRP 39-1983) Natural sources of radiation can be grouped in three types according to origin: Cosmic radiation, from the sun and from outer space, varies with altitude and latitude; Cosmogenic radio-nuclides (mainly carbon-14), produced through interaction of cosmic rays with atoms in the atmosphere; and Primordial radio-nuclides, which have existed in the earth's crust throughout history (for example, potassium-49 and nuclides in the uranium and thorium decay series).

Coulomb

Unit of electrical charge in the practical system of units. A quantity of electricity equal to 3×10^9 electrostatic units of charge.

Count, (Radiation Measurement)

The external indication of a device designed to enumerate ionizing events.

Counter, Gas Flow

A device in which an appropriate atmosphere is maintained in the counter tube by allowing a suitable gas to flow slowly through the sensitive volume.

Counter, Proportional

Gas-filled radiation detection device; the pulse produced is proportional to the number of ions formed in the gas by the primary ionizing particle.

Counter, Scillation

(RHH-1970) The combination of a phosphor, photmultiplier tube, and associated circuits for counting light emissions produced in the phosphors.

Counting, Coincidence

(RHH-1970) A technique in which particular types of events are distinguished from background events by coincidence circuits which register coincidence caused by the type of events under consideration,

Counting Channel

(ANSI N42.15-1980) A region of the pulse-height spectrum that is defined by upper and lower boundaries set by discriminators.

Counting Efficiency

(ANSI N42.15-1980) The ratio of the count rate to the disintegration rate, usually expressed as a percentage; where, E = counting system efficiency; R = the net count rate in an individual measurement, counts per minute, and A = activity of the radio-nuclide in the check source, disintegration per minute.

Curie

(HPJ 60-1991) The quantity of radioactive nuclides disintegrating at the rate of 3.7 x 1010 atoms per second (abbreviated Ci). Several fractions of the curie are in common usage.

Millicurie: One thousandth of a curie (3.7 x 107 disintegration per second), abbreviated mCi.

Microcurie: One millionth of a curie (3.7 x 104 disintegration per second), abbreviated µCi.

Nanocurie: One billionth of a curie (3.7 a 101 disintegration per second), abbreviated nCi.

Picocurie: One millionth of a microcurie (3.7 x 102 disintegration per second or 2.22 disintegration per minute), abbreviated pCi.

Femtocurie: One billionth of a microcurie (3.7 x 10-5 disintegration per second), abbreviated fCi.

Attocurie: One millionth of a picocurie (3.7 x 10-8 disintegration per second), abbreviated aCi.

Crosstalk

The number of erroneous counts in a counting channel (alpha or beta) in systems with multiple detectors. This effect is usually small unless there is electronic pick up between detector pulse-processing chains or in cases where inadequate shielding allows charged particle or other ionizing radiation to be scattered into another detector.

Daughter Products

(HPJ 60-1991) Isotopes that are formed by the radioactive decay of some other isotope. In the case of ^{226}Ra, for example, there are 10 successive daughter products, ending in the stable isotope ^{206}Pb.

Data File

Any file created within an application: a word processing document, a spreadsheet, a database file, a chart, and so forth. Also known as document.

Dead Time (td)

(ANSI N42.12-1980) The time after triggering a pulse during which the system is unable to retrigger.

Decay, Radioactive

(ANSI N1.1-1976) A spontaneous nuclear transformation in which particles or gamma radiation of x radiation is emitted following orbital electron capture or the nucleus undergoes spontaneous fission.

Decay Chain or Decay Series

(BEIR IV-1988) A sequence of radioactive decays of the same nucleus. An initial nucleus, the parent, decays into a daughter nucleus that differs from the first by whatever particles were emitted during the decay. If further decays take place, the subsequent nuclei are also called daughters. Sometimes to distinguish the sequence, the daughter of the first daughter is called the granddaughter, etc.; ordinarily, this quickly becomes too complicated.

Decay Constants

(ICRU 33—1980) The decay constant of a radio-nuclide in a particular energy state is the quotient dP by dt, where dP is the probability of a given nucleus undergoing a spontaneous nuclear transition from that energy state in the time interval dt.

Decay Curve

(RHH-1970)(HPJ 60-1991) A curve showing the relative amount of radioactive substance remaining after any time interval.

Decay Product

(HPJ 60-1991) A nuclide resulting from the radioactive disintegration of a radionuclide, being formed either directly or as a result of successive transformation in a radioactive series. A decay product can be either radioactive or stable.

Default Button

The command button in some dialog boxes selected as the most logical or safest choice. This button has a bold border when the dialog box appears, and pressing ENTER chooses the button.

Decay, Constant

The fraction of the number of atoms of a radioactive nuclide which decay in unit time (see disintegration constant).

Derived Air Concentration (DAC)

(ICRP 30-1978) (NCRP 87-1987) (HPJ 60-1991) Equals the ALI of a radio-nuclide divided by the volume of air inhaled by Reference Man in a working year (for example, 2.4×10^3 m^3). The unit of DAC is Bq m^3.

Detection Limit

(ANSI N42.17a-1989) (ANSI N42.17B-1989) (ANSI N42.17B-1989) (ANSI N42.17C-1989) The extreme of quantification for the radiation of interest by the instrument as a whole or an individual readout scale or decade. The lower detection limit is the minimum quantifiable instrument response or reading. The upper detection limit is the maximum quantifiable instrument response or reading. Quantifiable, in this case, means with the specified accuracy.

Detector, Radiation

An instrument used to determine the presence of, and sometimes the amount, of radiation.

Dialog Box

A rectangular box that either requests or provides information. Many dialog boxes present options to choose among before Windows can carry out a command. Some dialog boxes present warnings or explain why a command cannot be completed.

Directory

A collection of files and subdirectories that are stored at the same location on a disk. The name of the directory identifies its location. Part of the structure for organizing your files on a disk. See also subdirectory.

Discriminator

An electronic circuit that outputs a logic pulse if the amplitude of the input pulse exceeds some assigned threshold.

Disintegration, Constant

The fraction of the number of atoms of a radioactive nuclide which decay in unit time; in the equation $N = N_o e^{-gt}$, where N_o is the initial number of atoms present and N is the number of atoms present after some time, *t*.

Disintegration, Nuclear

A spontaneous nuclear transformation (radioactivity) characterized by the emission of energy and/or mass from the nucleus. When numbers of nuclei are involved, the process is characterized by a definite half-life.

Double-Click

To rapidly press and release a mouse button twice without moving the mouse. Double-clicking carries out an action, such as opening an icon.

Efficiency (Counter or Detector)

A ratio of the number of counts recorded relative to the number of nuclear transformations occurring. The specific definition varies depending upon the factors included in the ratio, such as geometry, window transmission, sensitive volume, and energy dependence.

Efficiency, Intrinsic (counters)

(ANSIN1.1-1976) A measure of the probability that a count will be recorded when a particle or photon of ionizing radiation is incident on a detector.

Electron

(ANSI N1.1-1976) A stable elementary particle having an electric charge equal to ± 1.60219×10^{-19} C. and a rest mass equal to 9.1095×10^{-31} kg. When used without specification the term means the negatively charged electron, which is also called a negatron or negaton. Its antiparticle, the positively charged electron, is called the positron or positon.

Element

Pure substance consisting of atoms of the same atomic number that cannot be decomposed by ordinary chemical means.

Energy Calibration

(ANSI N42.12-1980) The relationship between the height of the amplifier output pulse and the energy of the photon originating in the radioactive source.

Energy, Ionizing

The average energy lost by ionizing radiation in producing an ion pair in a gas. For air it is about 33 eV.

Error, Statistical

(RHH-1970) (HPJ 60-1991) Errors in counting due to the random time-distributions of disintegration.

Excitation

The addition of energy to a system, thereby transferring it from its ground state to an excited state. Excitation of a nucleus, an atom or a molecule can result from absorption of photons or from inelastic collisions with other particles.

File

A document or application that has been given a name. All documents are stored as files in Windows.

Fission Product

(NCRP 75-1983) (NCRP 81-1985) Any radio-nuclide or stable nuclide resulting from nuclear fission, including both primary fission fragments and their decay products.

Focus

The currently selected Windows document.

Gamma Radiation

(ENV RAD-1987) A ray of energy in contrast to beta and alpha particles' radiation. The properties are similar to those of X-rays and other electromagnetic waves. Gamma radiation is highly penetrating but relatively low in ionizing potential.

Gamma Ray

Short wavelength electromagnetic radiation of nuclear origin with a range of wavelengths from about 10^{-8} to 10^{-11} cm, emitted from the nucleus.

Gas Amplification

(RHH-1970) As applied to gas ionization radiation detecting instruments, the ratio of the charge collected to the charge produced by the initial ionizing event.

Geiger-Mueller (G-M Counter)

(NCRP 65-1980) A radiation detection and measuring instrument. It consists of a gas-filled (Geiger-Mueller) tube containing electrodes, between which there is an electrical voltage but no current flowing. When ionizing radiation passes through the tube, a short intense pulse of current passes from the negative electrode to the positive electrode, and is measured or counted. The number of pulses per second measures the intensity of radiation. It is also often known as a Geiger counter; it was named for Hans Geiger and W. Mueller who invented it in the 1920's.

Geiger Region

(RHH-1970) In an ionization radiation detector, the operating voltage interval in which the charge collected per ionizing event, is essentially independent of the number of primary ions produced in the initial ionizing event.

Geometry (good, bad)

(ANSI N1.1-1976) A term used colloquially to signify the arrangement in space of the various components in an experiment, as in, for example, plane geometry, or 2 p geometry. In beam0attenuation measurements, good geometry means that a material whose cross section is to be measured is interposed between source and detector so that scattering as well as absorption in the material reduces the detection rate. With bad-geometry, there may be scattering of the beam into the detector volume as well as away from it.

Germanium

(HPJ 60-1991) Symbol Ge. Element with atomic number 32. It is a semiconductor and used as the sensitive element in some g-ray detectors.

Guard Detector

A detector used in anti-coincidence counting to reject events from cosmic rays. When an event occurs in both the sample and guard detector within an assigned time interval, the count is not added to the channel accumulating the data.

Ground State

The state of a nucleus, atom or molecule at its lowest energy. All other states are "excited."

Half-Life, Radioactive

Time required for a radioactive substance to lose 50% of its activity by decay. Each radio-nuclide has a unique half-life.

Half-Value Layer (Half Thickness)

The thickness of any particular material necessary to reduce the intensity of a radiation beam to one-half its original value.

Icon

A graphical representation of various elements in Windows, such as disk drives, applications, and documents.

In Growth, Radioactive

(HPJ 60-1991) Increase in number of daughter atoms present as a result of radioactive decay of the parent.

Indirect Bioassay

(ANSI N13.30-1989D) Measurements to determine the presence of or to estimate the amount of radioactive material in the excreta of other biological materials removed from the body. (Synonymous with in-vitro measurement.)

Instrument

(ANSI N42.17A-1989) (ANSI N42.17B-1989) (ANSI N42.17C-1989) A complete system designed to quantify one or more characteristics of ionizing radiation or radioactive material.

Internal Conversion

(RHH-1970) One of the possible mechanisms of decay from the meta-stable state (isometric transition) in which transition energy is transferred to an orbital electron, causing its ejection from the atom. The ratio of the number of internal conversion electrons to the number of gamma quanta emitted in the de-excitation of the nucleus is called the "conversion ratio."

Inverse Square Relation

(NCRP 51-1977) That rule which states that the intensity of radiation from a point source decreases as 1/d2 from the source in a non-absorbing medium, where d is the distance from the source.

Ion Exchange

(RHH-1970) (BEIR III-1980) A chemical process involving reversible interchange of ions between a solution and a particular solid material. Such as an ion exchange resin consisting of a matrix of insoluble material interspersed with fixed ions of a charge opposite to that in solution.

Ion Pair

Two particles of opposite charge, usually referring to the electron and positive atomic or molecular residue resulting after the interaction of ionizing radiation with the orbital electrons of atoms.

Ionization

The process by which a neutral atom or molecule acquires a net positive or negative charge.

Ionization Chamber

(NCRP 65-1980) (HPJ 60-1991) An instrument that detects and measures ionizing radiation by measuring the electrical current that flows when radiation ionized gas in a chamber, making the gas a conductor of electricity.

Ionizing Radiation

(BEIR V-1990) Radiation sufficiently energetic to dislodge electrons from an atom. Ionizing radiation includes x and gamma radiation, electrons (beta radiation), alpha particles (helium nuclei), and heavier charge atomic nuclei. Neutrons ionize indirectly by colliding with atomic nuclei.

Ionization, Total

The total electric charge of one sign on the ions produced by radiation in the process of losing all of its kinetic energy. For a given gas, the total ionization is closely proportional to the initial ionization and is nearly independent of the nature of the ionizing radiation. It is frequently used as a measure of radiation energy.

Ionization Density

Number of ion pairs per unit density.

Ionization Path (Track)

The trail of ion pairs produced by an ionizing radiation in its passage through matter.

Isobar

One of two or more different nuclides having the same mass number but differing in atomic number.

Isomer

One of several nuclides having the same number of neutrons and protons but capable of existing, for a measurable time, in different quantum states with different energies and radioactive properties. Commonly, the isomer of higher energy decays to one with lower energy by the process of isomeric transition.

Isotope, Stable

A non-radioactive isotope of an element.

Isotope

One of several nuclides having the same number of protons in their nuclei, and hence having the same atomic number, but differing in the number of neutrons, and therefore in the mass number. Almost identical chemical properties exist between isotopes of a particular element. The use of this term as a synonym for nuclide is to be discouraged.

keV

The symbol for 1000 electron volts, or 10^3 eV.

Labeled Compound

(RHH-1970) (BEIR III-1980) A compound consisting, in part, of labeled molecules; by observation of radioactivity or isotopic composition, this compound or its fragments may be followed through physical, chemical or biologic processes.

Laboratory Standard

(NCRP 97-1988) In this report, a ^{226}Ra solution prepared from an NBS certified source and used to deliver a known amount of rate of production of ^{222}Rn.

Licensed Materials

(10CFR20-1987) Source material, special nuclear material. Or byproduct material received, possesses, used or transferred under a general or specific license issued by the Commission pursuant to the regulations in 10CFR20.

Liquid Scintillation Solution

(ANSI N42.15-1980) A solution consisting of and organic solvent (or mixture of solvents) and one or more organic scintillator solutes.

List Box

Within a dialog box, a box listing available choices — for example, the list of all available files in a directory. If all the choices will not fit, the list box has a vertical scroll bar.

Lower Limit of Detection

(ANSI N13.30-1989D) The amount of analyte material that has a 95% chance of being detected when the decision that some amount of analyte is present is made when a signal occurs at or above the decision level. It has the same meanings as minimum detectable amount (MDA), which is preferred terminology for this standard.

Mass Attenuation

See Attenuation

Mass Number

The number of nucleons (protons and neutrons) in the nucleus of an atom.

Maximize Button

The small box containing an Up arrow at the right of the title bar. Mouse users can click the Maximize button to enlarge a window to its maximum size. Other users can use the Maximize command on the Control menu.

MDA

An acronym for Minimum Detectable Activity. Although specific formulations vary, the MDA is a measure of the detection limit based on the statistical precision assigned by the operator.

Menu

A list of items, most of which are Windows commands. Menu names appear in the menu bar near the top of the window. You use a command on a menu by selecting the menu name, then choosing the command.

Menu Bar

The horizontal bar containing the names of all the application menus. It appears below the title bar.

MeV

The symbol for 1 million electron volts, or 10^6e V.

Minimize Button: The small box containing a Down arrow at the right of the title bar. Mouse users can click the Minimize button to shrink a window to an icon. Other users can use the Minimize command on the Control menu.

Minimum Detectable Activity (MDA)

See MDA

Monitor, Radiation

(ANSI N1.1-1976) A radiation detector whose purpose is to measure the level of ionizing radiation (or quantity of radioactive material) and possibly give warning when it exceeds a prescribed amount. It may also give quantitative information on dose or dose rate. The term is frequently prefaced with a word indicating the purpose of the monitor, such as: area monitor, air particulate monitor.

Nanocuire (nCi)

(NCRP 65-1980) A one billionth (10-9) part of a Curie or 37 nuclear transformation per second.

Natural Thorium

(ANSI N7.2-1963) Natural thorium is a mixture of two isotopes of element number 90, Th-232 and Th-228. Both of these isotopes occurring in the thorium radioactive series, Th-232 being the series parent and Th-228 its daughter by one a and two b transformations. Both isotopes are a emitters with respective half-lives of 1.39 z 10^{10} years and 1.91 years. The specific a activity of the mixture is 4.9 x 10^2 dpm per mg. The approximate proportions by weight, in nature or at a time of separation, are approximately seven billion parts of Th-232 to one part of Th-228. Thorium-228 fathers a line of a, b and g emitted having short half-lives. In-growth of these daughters upon the 3.64 day half-life of radium-224 (ThX) which is the first daughter of Th-228. Natural thorium, therefore, is free from daughter radiation for only a brief period of time following its separation.

Natural (or Normal) Uranium

(ANSI N7.2-1963) Naturally occurring uranium, atomic number 92, and atomic weight 238.07, is a mixture consisting of 99.28 percent U-238, 0.71 percent U-235, and 0.00580 percent U-234 (formed by the decay of U-238). All three isotopes are a-active with half-lives of 4.51 x 10^9 y, 7.13 x 10^8 y, and 2.48 x 10^5 y, respectively. Natural uranium has a specific a activity of 1502.0 ± 1.5 dpm per mg, of which 737.4 ± 1.6 dpm (49.1 percent) is due to U-234, 27.2 ± 3.5 dpm (1.8 percent) is due to U-235, and 737.4 ± 1.6 dpm (49.1 percent) is due to U-238. The term “natural uranium” or the alternate term “normal uranium” as used in this standard may apply to the metal, the metallic alloys or to uranium compounds (oxides, carbides, and so forth).

Naturally Occurring

(RRM-1987) Occurring naturally in the soil, not caused by industrial or other human activity.

Neutrino

A neutral particle of very small rest mass postulated to account for the continuous distribution of energy among the particles in the beta-decay process and to allow for conversation of momentum in beta decay.

Neutron

Elementary nuclear particle with a mass approximately the same as that of a hydrogen atom and electrically neutral; its mass is 1.008982 mass units. Neutrons are commonly divided into sub-classifications according to their energies as follows: thermal, around 0.025 eV; epithermal, 0.1 eV to 100 eV; slow, < 100 eV; intermediate, 102 to 103 eV; fast, > 0.1 MeV.

Nucleon

Common name for a constituent particle of the nucleus; applied to protons and neutrons, but will include any other particle found to exist in the nucleus.

Nucleus (Nuclear)

That part of an atom in which the total positive electric charge and most of the mass are concentrated.

Nuclide

A species of atom characterized by the constitution of its nucleus. The nuclear constitution is specified by the number of protons, Z, number of neutrons, N, and energy content; or, alter-natively, by the atomic number Z, mass number A = (N + Z), and atomic mass. To be regarded as a distinct nuclide, the atom must be capable of existing for a measurable time; thus nuclear isomers are separate nuclides, whereas promptly decaying excited nuclear states are unstable intermediates in nuclear reactions are not so considered.

Optically Coupled

(HPJ 60-1991) A process of matching the refractive index of optical media; the space between the window of a scintillation detector and the window of a photomultiplier tube coupled to the detector is filled with a transparent material such as high viscosity silicon fluid with a refractive index close to that of the two windows.

Plateau

As applied to radiation detector chambers, the level portion of the counting rate-voltage curve where changes in operating voltage introduce minimum changes in the counting rate.

Plateau Slope, Relative

The relative increase in the number of counts as function of voltage expressed in percentage per 100 volts increase above the Geiger threshold.

Positron

Particle equal in mass to the electron and having an equal but opposite charge.

Power, Stopping

A measure of the effect of a substance upon the kinetic energy of a charged particle passing through it.

Proportional Region

Voltage range in which the gas amplification is greater than one, and in which the charge collected is proportional to the charge produced by the initial ionizing event.

Proton

Elementary nuclear particle with a positive electric charge equal numerically to the charge of the electron and with a mass of 1.007 277 mass units.

Reaction (Nuclear)

An induced nuclear disintegration, that is, a process occurring when a nucleus comes into contact with a photon, an elementary particle or another nucleus. In many cases the reaction can be represented by the symbolic equation: X + a ® Y + b or, in abbreviated form, X(a, b)Y, in which X is the target nucleus, a is the incident particle or photon, b is an emitted particle or photon, and Y is the product nucleus.

Restore Button

The small box containing a Down arrow and an Up arrow at the right of the title bar. The Restore button appears after you have enlarged a window to its full size. Mouse users can click the Restore button to return the window to its previous size. Other users can use the Restore command on the Control menu.

Root Directory

The highest directory of a disk. The root directory is created when you format the disk. From the root directory, you can create other directories.

Scattering

Change of direction of subatomic particle or photon as a result of a collision or interaction.

Scroll Bars

The bars at the bottom and right edge of a window whose contents are not entirely visible. Each scroll bar contains a small box, called a scroll box, and two scroll arrows to allow different types of scrolling.

Scroll

To move text or graphics up or down or left or right, in order to see parts of the file that cannot fit on the screen.

Select

To highlight an item by clicking it with the mouse or using key combinations. Selecting does not initiate an action. After selecting an item, you choose the action you want to effect the item. See also choose and highlighted.

Selection Cursor

The marking device that shows where you are in a window, menu or dialog box. The selection cursor can appear as a highlight or as a dotted rectangle around the text in a dialog box option.

Self-Absorption

Absorption of radiation (emitted by radioactive atoms) by the material in which the atoms are located; in particular, the absorption of radiation within a sample being assayed.

Specific Activity

Total activity of a given nuclide per gram of a compound, element or radioactive nuclide.

Spillover

The number of erroneous counts in a counting channel (alpha or beta) in systems capable of simultaneous counting. Alpha-into- beta crosstalk occurs when the higher energy alpha particle creates a smaller charge within the detector because of a non-uniform detector response. Beta-into-alpha crosstalk occurs when the beta particle backscatters into the sensitive volume, creating a larger charge.

Spillover Correction

A mathematical method for correcting crosstalk effects that have been calibrated.

Standard, Radioactive

A sample of radioactive material, usually with a long half-life, in which the number and type of radioactive atoms at a definite reference date and time is known. It is used as a radiation source for calibrating radiation measurement equipment.

Text Box

A box within a dialog box where you type information needed to carry out the chosen command. The text box may be blank when the dialog box appears or may contain text.

Text File

A file containing only letters, digits, and symbols. A text file usually consists of characters coded from the ASCII character set.

Tile

A way of arranging open windows on the desktop so that no windows overlap but all windows are visible. Each window takes up a portion of the screen.

Title Bar

The horizontal bar located at the top of a window and containing the title of the window. On many windows, the title bar also contains the Control-menu box and Maximize and Minimize buttons.

Tritium

(^{3}H or T) The hydrogen isotope having one proton and two neutrons in the nucleus.

Unknown

A term used for samples in which the activities of various analytes are unknown.

Wildcard Character

A character that represents another character. In filenames, you can use the asterisk (*) as a wildcard character to indicate any character or group of characters that might match that position in other filenames. For example, *.EXE represents all files that end with the .EXE filename extension.

X Rays

Penetrating electro-magnetic radiation having wavelengths shorter than those of visible light. Bombarding a metallic target with fast electrons in a high vacuum usually produces them. In nuclear reactions it is customary to refer to photons originating in the nucleus as gamma rays and those originating in the extranuclear part of the atom as X rays.

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CANBERRA

Canberra's product warranty covers hardware and software shipped to customers within the United States. For hardware and software shipped outside the United States, a similar warranty is provided by Canberra's local representative.

DOMESTIC WARRANTY

Canberra (we, us, our) warrants to the customer (you, your) that equipment manufactured by us shall be free from defects in materials and workmanship under normal use for a period of one (1) year from the date of shipment.

We warrant proper operation of our software only when used with software and hardware supplied by us and warrant that our software media shall be free from defects for a period of 90 days from the date of shipment.

If defects are discovered within 90 days of receipt of an order, we will pay for shipping costs incurred in connection with the return of the equipment. If defects are discovered after the first 90 days, all shipping, insurance and other costs shall be borne by you.

LIMITATIONS

EXCEPT AS SET FORTH HEREIN, NO OTHER WARRANTIES, WHETHER STATUTORY, WRITTEN, ORAL, EXPRESSED, IMPLIED (INCLUDING WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE) OR OTHERWISE, SHALL APPLY. IN NO EVENT SHALL CANBERRA HAVE ANY LIABILITY FOR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL LOSSES OR DAMAGES OF ANY NATURE WHATSOEVER, WHETHER AS A RESULT OF BREACH OF CONTRACT, TORT LIABILITY (INCLUDING NEGLIGENCE), STRICT LIABILITY OR OTHERWISE.

EXCLUSIONS

Our warranty does not cover damage to equipment which has been altered or modified without our written permission or damage which has been caused by abuse, misuse, accident or unusual physical or electrical stress, as determined by our Service Personnel.

We are under no obligation to provide warranty service if adjustment or repair is required because of damage caused by other than ordinary use or if the equipment is serviced or repaired, or if an attempt is made to service or repair the equipment, by other than our personnel without our prior approval.

Our warranty does not cover detector damage due to neutrons or heavy charged particles. Failure of beryllium, carbon composite, or polymer windows or of windowless detectors caused by physical or chemical damage from the environment is not covered by warranty.

We are not responsible for damage sustained in transit. You should examine shipments upon receipt for evidence of damage caused in transit. If damage is found, notify us and the carrier immediately. Keep all packages, materials and documents, including the freight bill, invoice and packing list.

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