## PRODUCTIVITY SOFTWARE

Apex-Alpha™

Alpha Spectroscopy Software Suite

KEY FEATURES

- Comprehensive operation and management software for the production-oriented alpha spectroscopy lab

- Distributed multi-user functionality for access to system resources from any client workstation

- A sample database that tracks batches of samples through log-in, counting and final data review/approval processes

- Intuitive tools for easy creation of sample batches with associated counting and analysis procedures

- Flexible and automated energy and efficiency calibration facilities

- Extensive quality assurance capability for scheduling of QA checks, failure identification and response and data trending

- Single screen data review and advanced reanalysis facilities

- Comprehensive event logging with flexible recall

- Integrated security system with different levels of access to system functions

- Genie™ 2000 spectroscopy software core provides well established algorithms for analysis of spectral data

- Supports manual alpha spectrometers and provides complete computer control of the Mirion Alpha Analyst™ Spectrometers

- Built-in tools to facilitate interfacing to external LIMS systems

- Windows 10 and Server 2016/2019 support

- Archive, Delete & Restore functionality

- ISO11929 support
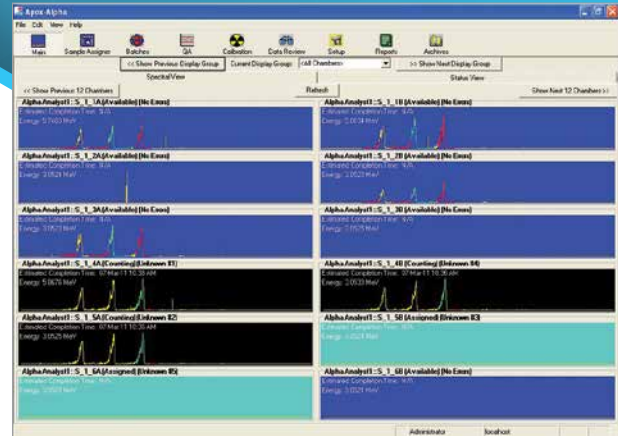
DESCRIPTION

Apex-Alpha software is the ***ultimate*** alpha spectroscopy software package for automating detector set-up and calibration, quality assurance, sample analysis and reporting activities in large or small alpha spectroscopy laboratories. This software package brings the productivity gains to alpha spectroscopy that the Apex® Lab Productivity Suite has brought to gamma spectroscopy for a number of years.

With Apex-Alpha software, the complete status of your alpha spectrometers is available at a glance. Click — and find all the batches waiting to be counted. Log samples into the system from any location where the information is known, such as from the radiochemistry laboratory or other sample log-in area. Let Apex-Alpha software enforce your calibration/QA schedules and monitor QA results — and automatically take the appropriate action if something goes wrong.

Alpha spectroscopy typically has specialized requirements for wet chemistry and sample preparation prior to counting. The quality of the sample prep plays a large role in determining the quality of the end results of sample analysis. Apex-Alpha software handles the requirements for tracers, reagent blanks, spikes, etc. with ease and can accommodate the counting, statistical analysis and quality assurance associated with any of these sample analysis methods that may be in use at your laboratory.

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The key to Apex-Alpha software lies in the extensive database built directly into the software. As batches of samples are logged into the system, a batch/sample database record is created which stays in the system as the sample moves through various stages of processing – counting, first and second data review, recounting (if necessary), final results and any follow-up inquiry. Built on modern relational database technology, Apex-Alpha software gives you a complete view of what is going on in your lab with quick, reliable answers to questions such as: How many samples await processing? Which samples await data review? Which samples were counted in alpha chamber 3, with a Pu in water matrix, and came from customer x in the last 30 days? These are all easy questions for Apex-Alpha software.

DISTRIBUTED OR LOCAL NETWORK ARCHITECTURE

Apex-Alpha software is designed on a multi-user, client/server model. Networked workstations allow you to operate from anywhere in the system (Figure 1).

A typical system may have several workstations located within the lab counting area, one or more in sample receiving areas for sample log-in and additional workstations in the supervisor or analyst's office for data review. This flexibility provides optimum information access and system control – the capability you need exactly where you need it.

Client/server systems may have the database and application software on the same server for a two-tier configuration or on different servers for a three-tier configuration. This flexibility allows the user to place the database on a corporate server outside of the lab for routine back-ups while keeping the Apex-Alpha application on another server closer in proximity to the clients it supports.

Groups of alpha spectrometers are controlled by dedicated client computers as determined at installation time – or a single client can control all the spectrometers – but all clients may have access to all batches/samples in the system for spectral review and analysis. This dedication of groups of spectrometers to specific clients for acquisition control makes most efficient use of computer and network resources while still allowing any client on the network to check the status of a count or perform data review.
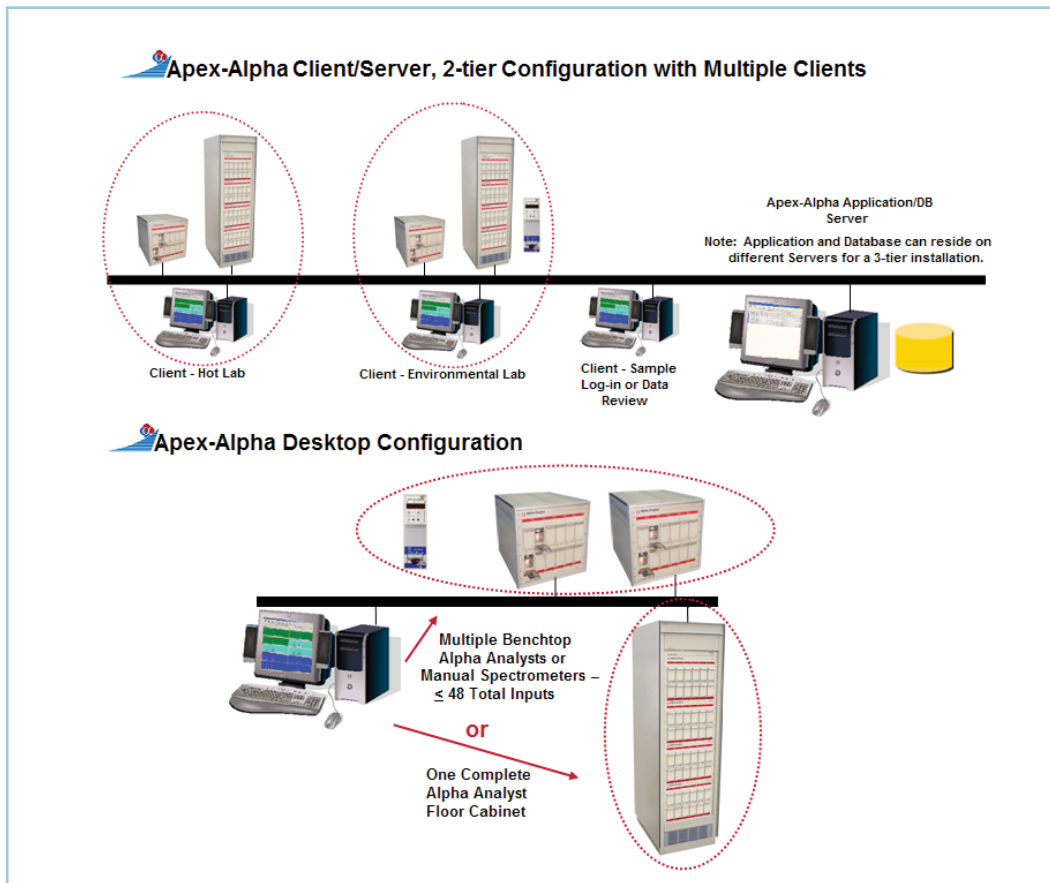

Figure 1.
Apex-Alpha Network Architecture.

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For laboratories with only a few spectrometers, or those that do not require multiple computer access to their alpha spectroscopy system, a Desktop version of Apex-Alpha software is available (Figure 1). All of the Desktop Apex-Alpha software, including an embedded SQL Server database, resides on a single computer. The Desktop version is capable of operating up to 48 alpha spectrometers. The hardware can be any combination of Benchtop Alpha Analyst systems or manual spectrometers up to a total of 48 inputs or a single, fully populated 48-input Floor Cabinet Alpha Analyst system.

Regardless of which configuration is chosen, Client/Server or Desktop, the same acquisition, analysis and quality assurance tools are provided. Both configurations offer the advantage of the established SQL Server relational database for efficient data storage, retrieval and interface to other applications such as Microsoft Visual Basic, Excel and Access.

Figure 2.
Batch editor screen.

SAMPLE COUNTING AND ANALYSIS

Until now, a sample was not typically "known" to the counting system until the moment it was placed in the alpha chamber. With Apex-Alpha software, samples can be logged into the system at the moment the requisite sample information is available – and from any location. Place a client workstation in the sample receiving/preparation area, and you can log samples directly into the system as a batch as they are prepared. In many cases, this can eliminate the need for a paper-based sample information sheet. Other users will find a simple, customized interface that allows download of sample lists directly from computerized Laboratory Information Management Systems (LIMS). In either case, Apex-Alpha software can eliminate manual processing of records, dramatically reducing transcription and data entry errors.

To efficiently manage a number of unknown samples and any associated quality assurance samples being counted at the same time, all the samples are grouped into batches and managed in that mode. With the batch creation utility (Figure 2), you simply point and click to create a new batch or edit an existing one for the new samples. You can also view counted batches in read-only mode.

In create batch mode, the batch editor screen provides a quick way to enter information about the samples to be included in the batch as well as the number of unknowns. The first page of the screen asks for generic information about the batch, and the second page allows the information entered in page one to be modified for each individual sample as necessary.

The batch editor screen has check boxes to specify which special samples will be included in the batch: Laboratory Control, Tracer Blank, Duplicate or Matrix Spike. You can also select the duplicate
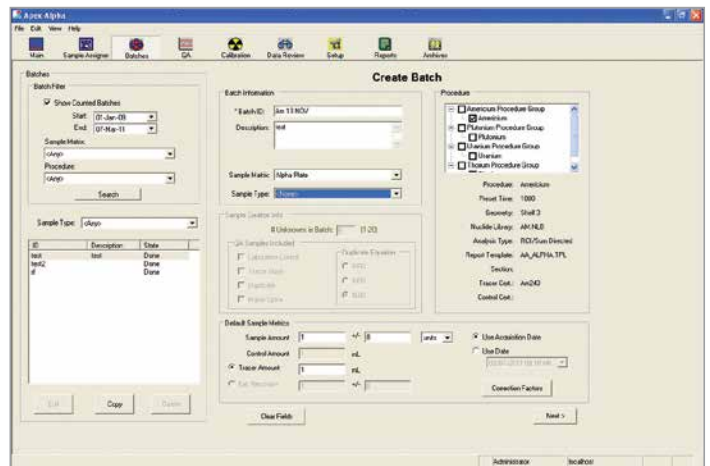
equation to be used for comparison of a duplicate QA sample to the original if one is present: Relative Percent Difference, Relative Error Ratio or Normalized Absolute Difference. The Default Sample Metrics feature allows the user to enter a sample amount, a control amount and an external recovery or tracer amount. The screen also includes optional parameters available via the Correction Factors button for: Systematic Error, Random Error, Generic Multiplier (x) and Generic Divisor 1/x factors. If these factors are selected, they are used as multipliers in the activity calculation.

To begin counting, just drag and drop the batch of samples into the desired available chambers. The Load Samples and Start Count sequence will immediately guide the user through the sample loading process, changing the color code of the chamber icons as they are assigned their samples to count. Figure 3 shows that placing a batch of six samples on the icon for the first available alpha chamber automatically assigns the batch to the next six available chambers in a single step and changes their icon colors.
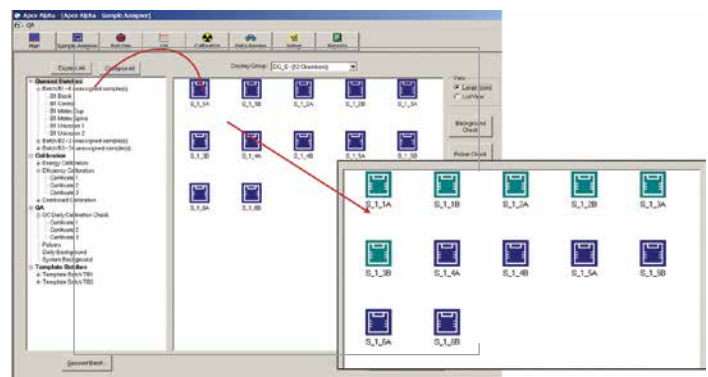

Figure 3.
Drag and drop batch loading.

Apex-Alpha ALPHA SPECTROSCOPY SOFTWARE SUITE

Apex-Alpha software employs an industry-leading Genie 2000 core components for analyzing spectra, creating analysis libraries and certificate files, and monitoring various sample preparation and detector/chamber related parameters for quality assurance purposes.

Analysis features include:

- Regions of Interest (ROI)-based analysis
- Tracer and tracer-less quantitative analysis
- Alpha chamber background correction
- Reagent/tracer blank correction
- Interactive peak fit
- Library driven peak locate

The following highlights some of the capabilities of Apex-Alpha software that make it intuitive and flexible for counting and analyzing samples whether hundreds of samples are processed per day or just a few on an occasional basis. These are features that will likely be used routinely to make the most efficient and effective use of available counting time and equipment.

- Display Groups allow the user to select specific combinations of chambers to be displayed together for a quick visual check of counts in progress – up to twelve spectra may be viewed at a time. If the group is larger than twelve chambers, one mouse click pages from one set of twelve to the next set.

- Batch information contains a sample type reference. This allows for easy retrieval at a later time when searching for a specific type of sample. A sample type can be a customer or project name, or it can represent a sample point, location, etc.

- The Chamber Names are customizable. They can be a sequential code, such as 001, 002, ..., assigned automatically by the system or can be changed to something more meaningful.

- A count rate alarm is available to provide an alert to possible recoil contamination of the detector. This allows the user to increase the distance between the detector and sample, increase the air pressure in the chamber or take some other laboratory specific precaution to lessen the possibility of detector contamination.

- Samples can be analyzed at any time during a count allowing the user to change acquisition times based on the initial results before the preset time is reached. Acquisition times can be extended for better statistical results with low level samples or shortened for increased sample throughput with hotter samples. Similarly, a count can be extended after the preset count time is reached if more time is needed to improve results.

- Instead of a preset count time, a preset "Tracer Peak Area" can be used to stop acquisition after a statistically significant number of counts have been acquired in the tracer region of interest.

- Creation of ROI files is easy. These files include predefined regions of interest for the peaks expected in a specific sample type. Assignment may be automatic or manually performed by the user, and the ROI limits for the isotopes of interest may be extracted directly from a nuclide library.

- The Tracer ROI can automatically be given a different color from any other ROIs during acquisition. This allows visual and immediate recognition of the tracer in the acquiring spectrum.

- Various MDA calculation algorithms are selectable and editable as necessary. Available algorithms include the Currie, KTA, and ISO 11929 methods with editable constant and multiplier where appropriate. Custom MDA calculations are supported via the Script engine in order to comply with any customer specific requirements.

- In the event of a power or network outage or other spectrometer communications related problem, several disaster recovery features are provided including:
  - Auto spectral back-up to a back-up file at certain intervals during a count.
  - Reconnect feature after a network communication failure.
  - Choice to reload a spectrum from back-up and continue counting, continue counting with whatever spectrum is in place for the chamber or abort the count and start over after interruption of a count.

CALIBRATION OPERATIONS MANAGEMENT

Another major Apex-Alpha feature is the full automatic energy and/or efficiency calibration (Figure 4). The automatic energy and efficiency calibration only requires that the calibration source is loaded in the counting chamber and the corresponding source certificate information is available to the system. Apex-Alpha software will count the source and execute the energy, shape and/or efficiency calibrations. No user interaction is required once the process is initiated! Review options are available, and manual interaction (add, remove or edit a data point) is also supported. The calibration results can also be tracked as part of the lab quality assurance program with automatic transfers of the results to the QA database.
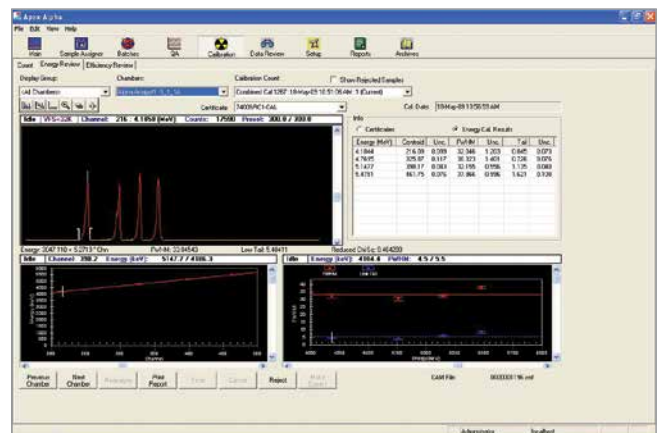

Figure 4. Energy/peak shape calibration review screen.

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If a user attempts to count in an alpha chamber with an overdue energy or efficiency calibration, Apex-Alpha software can either log the error, warn the operator or prevent counting in that chamber entirely (as specified by the system administrator). This capability assures that only chambers/detectors that are properly calibrated can be used for counting production samples and eliminates the need for a separate, external calibration log to maintain the calibration records.

QUALITY ASSURANCE MANAGEMENT

Quality assurance is critical to alpha spectroscopy in that the accuracy of results is dependent upon both meticulous sample preparation as well as the actual counting of the sample. This means that sample preparation checks must be performed in addition to the traditional detector background, efficiency and energy checks that are done with gamma spectroscopy systems.

Instead of having these various parameters monitored externally, Apex-Alpha software has the ability to automatically monitor all of them within its own quality assurance module. Figure 5 shows how to select data for QA reports based on detector/chamber parameters or on sample chemistry parameters including the matrices and elements of choice. The QA Summary Report provides an overview of a particular QA parameter of interest for a user selected group of counting chamber(s) and time frame. Figure 6 shows an example summary report with the results of an energy calibration check.
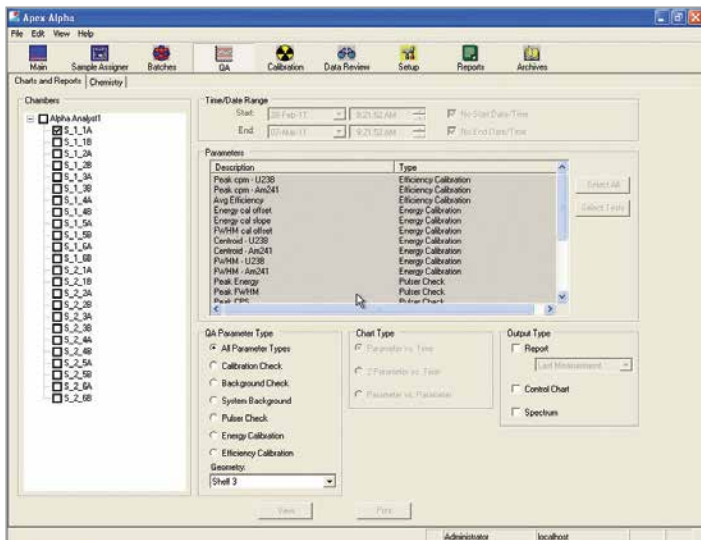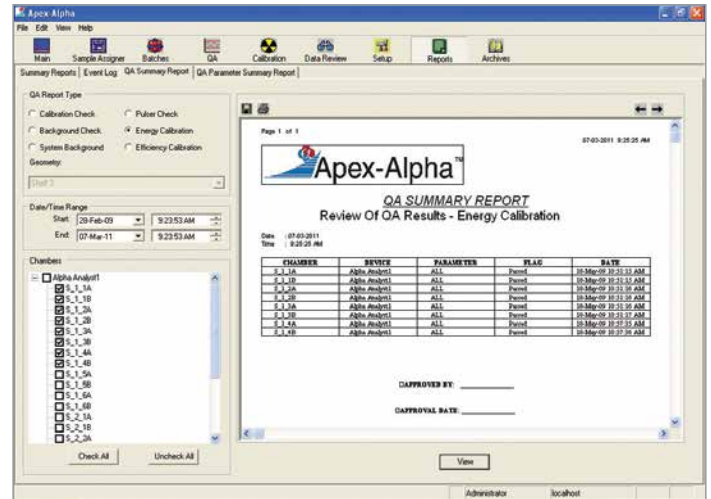

Figure 6.
Energy calibration QA Summary Report.

Standard Chamber (or detector) oriented QA parameters that can be monitored include:

- Energy, shape and/or efficiency calibration check
- Background check
- System background
- Pulser check
- Energy calibration
- Efficiency calibration

The QA file is linked to the serial numbers of PIPS® detectors in use in the alpha spectrometers. This allows the detectors to be swapped in and out of the counting chambers over time but continue to be monitored by the QA module whenever they are installed in the chambers.

Standard Sample oriented QA parameters that can be monitored on a per element/matrix basis as appropriate include:
- Laboratory Control Sample (LCS) recovery
- Duplicate Sample recovery and difference from primary sample
- Tracer Blank recovery
- Tracer recovery
- Matrix Spike recovery
- Sample specific (track sample results over time)

Figure 5.
QA report selection screens – chamber and chemistry.

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The quality assurance module does much more than just collect, report and trend QA data. It can prevent sample counting in a suspect chamber if a QA check is overdue or if QA check results for the chamber are outside of acceptable boundaries as determined by the system administrator.

The administrator has three options at his disposal depending on the severity of a particular QA violation. If a QA count is overdue or if QA check results are outside of either the Investigate Level or Action Level as determined by an n-sigma test, any one of these actions can be taken before a sample is counted:

• Lock Chamber: The QA violation is written to the database. Further sample counting is prevented in the chamber until a new QA count has been performed, analyzed and the chamber has been manually placed back online by an authorized user.

• Warning: The QA violation is written to the database, and a warning is displayed. The user is given the option of counting the sample anyway.

• Log Failure: The QA violation is written to the database, but no further actions are taken.

DATA REVIEW, REANALYSIS AND APPROVAL

It is not unusual for a hundred or more alpha spectroscopy samples to be counted in a single day in the larger production laboratories. This creates monumental amounts of data that must be readily accessible at all times for final approval once the counting and initial analysis is complete. The data must also be available long-term for audits or re-evaluation long after the initial sample analysis has been archived. Apex-Alpha software is unique in the way it handles counting data as compared to previous generations of alpha spectroscopy software. Instead of storing bits and pieces of information in various individual files, Apex-Alpha software is driven by a relational database. This software design provides for easy storage and retrieval of calibration, QA and sample data whether the count of interest was performed today, a week ago or any time in the past.

Another key feature of Apex-Alpha software is its simple, but powerful, interface for locating the data you need. The extensive database filters in the data review search engine (Figure 7) make it very easy to narrow down the search criteria and find the desired information instantaneously.

Once the sample is found, all the necessary count information is presented on a single screen (Figure 8). At that point, an operator with proper privileges has the option of approving the results or reanalyzing the sample should that be necessary. Special attention has been given to the way the user can manipulate the ROIs in the spectrum. ROIs can be adjusted individually or all shifted to the right or left together. Or, if there is a need to extend the left side of the all ROIs to accommodate low tailing, this is possible in a single operation as well.

Once approved, Apex-Alpha software has built-in tools to simplify the export of results into computerized Laboratory Information Management Systems (LIMS) or other databases. Again, there is no need for a paper system or manual retyping of data into a separate database. This interface capability saves valuable time and eliminates transcription errors.
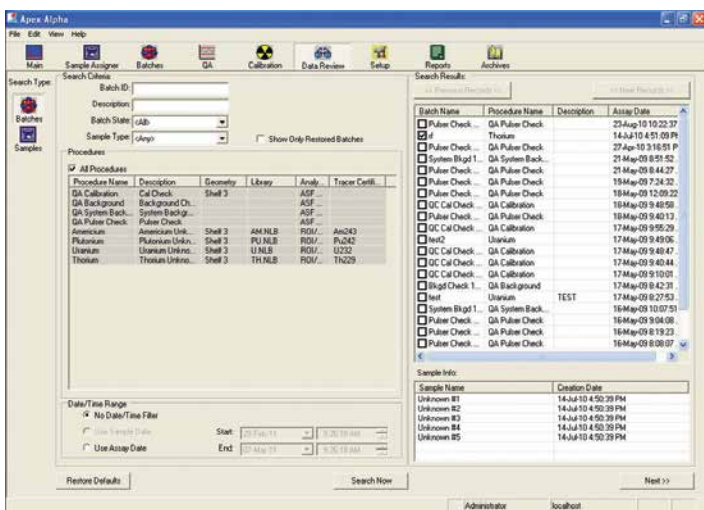

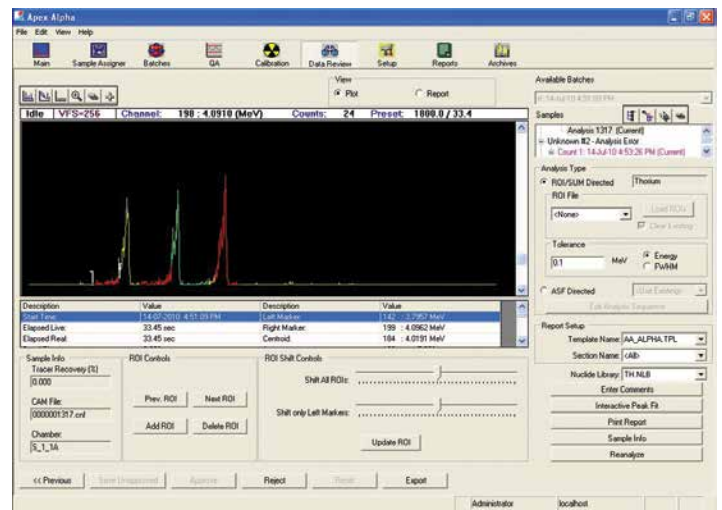Figure 7.
Data review search screen.

Figure 8.
Data review/approval screen.

Apex-Alpha **ALPHA SPECTROSCOPY SOFTWARE SUITE**

EVENT LOG AND SYSTEM SECURITY FEATURES

For verifying and correcting results as needed – even years after the initial count – and controlling access to critical parts of the system, you can rely on Apex-Alpha software's event log and security system.

The ability to retrieve information, retrace steps, review history – at any time – is very important to lab operations. Whether for the purposes of performance review or determining how many samples might have been impacted if a problem is found in the lab, rapid and complete information retrieval can save huge amounts of time and money. Apex-Alpha software automatically logs every event into a database table. Every log-on/off, sample count, calibration, QA check, data review, etc. is recorded and can be recalled whenever needed.

Data and system security is a hallmark of all Mirion application software. Apex-Alpha software is certainly no exception, and its security capability is both extensive and flexible.

The system administrator plans the security set-up by determining the numbers of different classes of operators there are and the functions that should be assigned to each class. Each class can consist of any number of individual users from a single sample approver to a number of count room technicians.

A group profile is created for each class using the Security Set-up editor (Figure 9). Once the groups have been established and privileges assigned to each one, individual users can then be assigned to the appropriate groups. Each user has a log-in password, and all activities performed while a user is logged on are associated with that user in the database.

The security system is easy to maintain as personnel enter or leave employment at the laboratory – just add or remove users to/from the appropriate groups. Also, any privilege can be assigned to any group at the discretion of the system administrator for maximum flexibility. There are no hard-coded hierarchies of privileges built into the security system, so the administrator is free to set up the system any way he sees fit.

ARCHIVE, DELETE, AND RESTORE

Apex-Alpha software provides database archiving functionality to help reduce the size of the database. Records can be archived to a backup database, deleted from the primary database, and restored back to the primary database when necessary. Archive functionality is limited to users only with acceptable security privileges. (See Figure 10.)
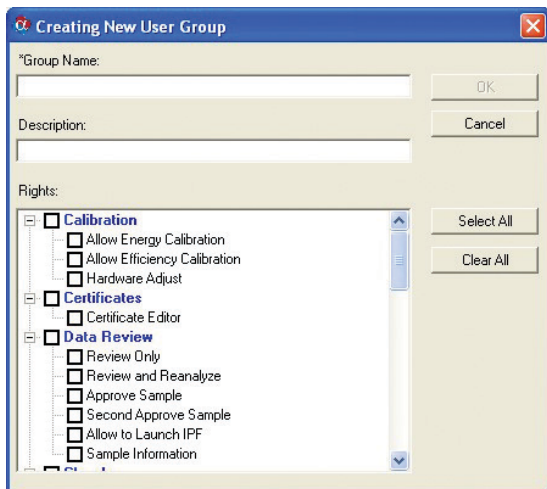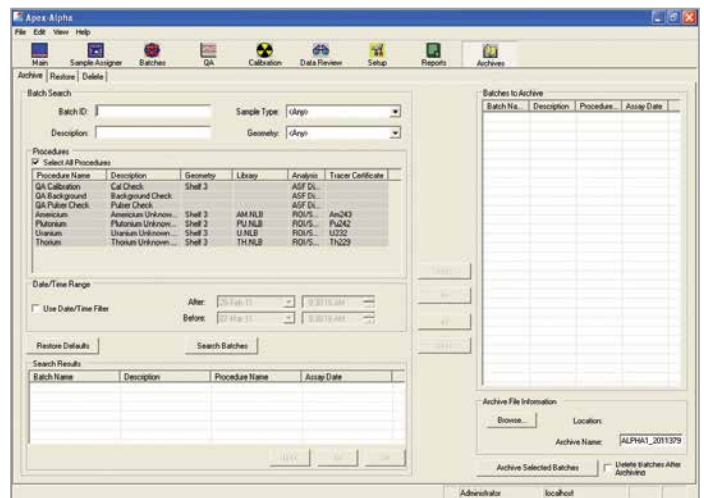

Figure 9.
Security set-up screens.

Figure 10.
Archive screen.

MIRION TECHNOLOGIES

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Apex-Alpha ALPHA SPECTROSCOPY SOFTWARE SUITE

SPECIFICATIONS

MINIMUM SYSTEM REQUIREMENTS*

Apex-Alpha Desktop
- Windows 10 Enterprise 64-bit
- Microsoft SQL Server 2016 Express Edition (included), SQL Server 2017 Express also supported.
- Ethernet 10/100 interface.
- Multi-core processor.
- 4 GB of system memory.
- 80-GB hard disk.

Apex-Alpha Server
- Windows 10 Enterprise 64-bit, or Windows Server 2016 64-bit or Windows Server 2019 64-bit.
- Microsoft SQL Server 2016 or 2019 – any edition except Express (licensed separately).
- Ethernet 10/100 interface.
- Quad-core or higher processor.
- 8 GB of system memory.
- 250-GB hard disk.

Apex-Alpha Client
- Windows 10 Enterprise 64-bit.
- Ethernet 10/100 interface.
- Multi-core processor.
- 4 GB of system memory.
- 80-GB hard disk.

All Apex-Alpha computers require the following minimum versions of Genie 2000 Spectroscopy Software
- S500 Basic Spectroscopy Multi-Input Software – Minimum Version 3.4.1 R2.
- S509 Alpha Analysis Software – Minimum Version 3.4.1 (or higher).
- S505 Quality Assurance Software – Minimum Version 1.3.
- S506 Interactive Peak Fit Software – Minimum Version 1.4.1.
  and/or
- S520 Genie 2000 Multi-Input, Right to Copy (to copy the above software to an additional computer).

ORDERING INFORMATION

S770C Apex-Alpha Desktop License
- Requires Genie 2000 packages.

S771C Apex-Alpha Server License
- Requires Genie 2000 packages and Microsoft SQL Server 2016 or 2019 – any edition except Express (licensed separately).

S772C Apex-Alpha Client License
- Requires Genie 2000 packages (or S520).

S775C Apex-Alpha Desktop/Genie 2000 Package
- Includes Genie 2000 packages.

Recommended Option: 7400-SRC Mixed Alpha Standard Source
- For Calibration and/or QA.
- Base certificate information for this source is already loaded into Apex-Alpha software to make set-up easier if this source is used.

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*Performance is enhanced with better computer resources – particularly memory.

ISO 9001 SYSTEM CERTIFIED

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