Focus on Quality

Validation of Spectrometry Software

Part VII – Training, System Documentation, and Writing the Validation Summary Report

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In our validation journey for a spectrometer and its software, we started with writing a system or user requirements specification, then progressed through the selection, implementation, and qualification of the system. We now come to the completion of the easy part of a system's validation: training, system documentation, and writing the validation report to release the system.

In this article we'll cover the validation summary report plus three other areas that we have not discussed before: system description, system documentation, and user training with the associated procedures.

System Description

Why do we need a system description? The simplest answer is that it is a regulatory requirement. The European Union GMP (1), the Organization for Economic Cooperation and Development (OECD) GLP Guidance (2), and the new Pharmaceutical Inspection Convention/Scheme (PIC/S) Guidance for Inspectors on Computerized Systems in GXP Environments (3), include the following requirements and statements on a system description:

European Union GMP Annex 11- Clause 4. A written detailed description of the system should be produced (including diagrams as appropriate) and kept up to date. It should describe the principles, objectives, security measures, and scope of the system and the main features of the way in which the computer is used and how it interacts with other systems and procedures.

OECD Consensus Document on the Application of GLP Principles to Computerized Systems For each application there should be documentation fully describing:

- The name of the application software or identification code and a detailed and clear description of the purpose of the application.• The hardware (with model numbers) on which the application software operates.
- The operating system and other system software used in conjunction with the application.
- The application programming languages and database tools used.
- The major functions performed by the application
- An overview of the type and flow of data/database design associated with the application.
- File structures, error and alarm messages, and algorithms associated with the application.
- The application software components with version numbers.
- Configuration and communication links among application modules and to equipment and other systems.

From the inspection perspective, this is quoted from the PIC/S Guidance:

> 23.13 The lack of a written detailed description of each system, (kept up-to-date with controls over changes), its functions, security and interactions (A11.4); a lack of evidence for the quality assurance of the software development process (A11.5), coupled with a lack of adequate validation evidence to support the use of GMP related automated systems may very well be either a critical or a major deficiency. The ranking will depend on the inspector's risk assessment judgement for particular cases. (NB. Since 1983, the GMPs have called for validated electronic data-processing systems and since 1992 for the validation of all GMP related computer systems).

Note the numbers in parentheses in the above paragraph refer to EU GMP Annex 11 clauses, and the reference to

GMP is European Union GMP, not FDA.

So you need a system description and it needs to be approved and controlled; the lack of this document can give rise to a critical or major observation. The purpose is to give an introduction to a spectrometer system. Simply use the regulations to give you the format for the document. Look at the framework from the OECD consensus document and base your description on this.

Some advice: you don't have to cram all the information into a single document. For instance, the hardware information could be found in the configuration management records for the spectrometer. Instead of duplicating the information in a second document and having to update two documents when a change is made, simply cross-reference the configuration management records in the system description. Furthermore, the system description should not be very long; it's a summary document - a description, not a specification.

Users and their Training Records

All involved with the selection, installation, operation, and use of a system should have training records to demonstrate that they are suitably qualified to perform their functions and maintain them. It is especially important to have training records and curricula vitae (résumés) of installers and operators of a system, as this is a particularly weak area and a system can generate an observation for noncompliance.

Major suppliers of spectrometer systems usually will provide certificates of training for installation of systems and software. However, a major weak spot for many suppliers that have their data or systems supported by their own IT department is that the IT staff does not have training records or curricula vitae. The types of personnel that could be involved in a validation are

Instrument vendor staff is responsible for the installation and initial testing of the spectrometer and the system software. They should leave copies of their training certificates listing the products they were trained to work on, which should be checked to confirm they are current and cover the relevant products.

System managers have training in the use of the system and administration tasks provided by the vendor.

Users are either analytical chemists or technicians who had their initial training by the vendor staff to use the data system; this is documented in their individual training records.

Consultants involved in aiding a validation effort must provide a curriculum vitae and a written summary of skills to include in the validation documentation.

IT staff should provide training records and job descriptions outlining the combination of education, training and skills that each member has.

System Documentation

The documentation supplied with the spectrometer and its accompanying software, user notes, and user standard operating procedures will not be discussed here as it is too specific and depends upon the management approach in an individual laboratory. However, the importance of this system-specific documentation for validation should not be underestimated. Users must know where to find the current copies of documentation to enable them to do their job.

Standard Operating Procedures. Standard operating procedures (SOPs) are required for the operation of both the software and the instrument itself; as explained above, we will not consider user SOPs in detail. SOPs are the main medium for formalizing the procedures for achieving a defined outcome. According to Hambloch (4), SOPs have the advantage that the same task is undertaken consistently and performed correctly. A written procedure means also that new employees are trained faster. The aim is to ensure a quality operation. Laboratory staff members are used to working with SOPs; and a central computer group might not be.However, to provide a service to a regulated laboratory, a computer department must provide a suitably documented procedure.

According to Hambloch there is a minimum list of 12 SOPs required for the operation of a computer system in a regulated or accredited laboratory:

SOP on SOPs: this should describe the approach taken to the writing of SOPs within the functional group, the sections, who can authorize the procedure, a description of the procedure, and distribution list.

Description of responsibilities: defines the roles and responsibilities of staff supporting the computer system.
Preventative maintenance: describes the procedures for preventative maintenance of the hardware components, if applicable.

Prevention, detection, and correction of errors: the measures and procedures for finding, recording, and resolving errors in the system. This can be a complex SOP covering many different aspects of the system and can refer to sections of the technical manuals provided with the system. This SOP includes good housekeeping such as monitoring the space available on all disks, especially given the size of some high-resolution spectrometry files.
System boot and shutdown: This is a special SOP that should contain all the specific instructions for starting up and shutting down the system. This SOP might be required in an emergency and therefore should be written well and be readily available for use.

Control of environmental conditions: For spectrometers that require a controlled environment, an SOP that defines the acceptable ranges of temperature, humidity, and power supply and how these parameters will be monitored if critical to the successful operation of the spectrometer.

Change control and configuration management: Uncontrolled changes to the system will mean your system is not validated; therefore a change control procedure is imperative. Allied to change control is configuration management that lists the components of the system and how these have changed over time. (This will be the subject of the next article in this series.)

Contingency plans and emergency operation: this is a disaster recovery

Table I: Content of a Validation Summary Report (Adapted from IEEE Standard 1012) (5)

Validation Statement and Release for Operational Use
Introduction
Purpose
Objective and Scope of Validation Efforts
Life Cycle Activities and Documented Evidence for System Validation
Evaluation of the Requirements Phase
Validation Plan
User Requirements Specification
Risk Analysis and Traceability Matrix
Evaluation of the Implementation Phase
Vendor Audit to cover Design, Programming, and Developer Testing
Summary of Implementation Phase
Evaluation of the Performance Qualification Phase
Writing Performance Qualification Test Plan and Test Scripts
Execution of the Performance Qualification Test Scripts
Performance Qualification Test Execution Notes
Summary of Performance Qualification Anomalies and Their Resolution
Evaluation of Training, Documentation, and Procedures
User Training
User Procedures
System Description
Deviations from Validation Plan and Their Impact on Quality
Validation Documentation

plan including the use of alternative plans until the computer system has been recovered. It is important that any disaster recovery plan is tested and verified before a disaster occurs.

Backup and restoration of data: Describes the procedures for backup of data and software programs and how to restore data to disk.

Security: The logical (software) and physical security of the system is covered with procedures for setting up and maintaining security including user account management.

Installation and updating of software: Procedures to be undertaken before, during, and after installing software. This should start with the complete backup of all disks and then installation of the software and any testing or validation that might be required.

Development and update of system software procedures: Software or macros can be written to control the system or to help execute functions. This SOP outlines the procedures for the creation, documentation, and modification of these procedures. This is a critical area, as each macro will be unique to an individual laboratory.

It is important to realize that the list above refers to a relatively large computer system;for smaller items this list should be reviewed for applicability and suitability. Where a system does not have the facility to store raw data (for example, a disk drive), then no SOP is required for backup and restoration. The same logic should be applied to the whole list. The converse is also true; for a more sophisticated system there might be a need for additional SOPs to those above.

Why Write a Validation Report?

The validation summary report (VSR) is the end of the initial validation effort, and as the name suggests, summarizes the work you have done. According to the PIC/S Guide (3):

Inspectors should review the firm's *Validation Summary Report**, (VSR) for the selected system and refer as necessary to the System Acceptance Test Specification and lower level documents. They should look for evidence that the qualification testing has been linked with the relevant specification's acceptance criteria, viz:

- Performance qualification versus user requirements specifications
- Supplier audit reports
- Validation plans

* VSR = A best practice high level report, summarizing the validation exercise, results and conclusions, linking via cross referencing to lower level project records, detailed reports and protocols. This is useful for briefing both senior managers, in regulated user organizations and for reference by auditors / inspectors.

The aim is a summary document, not a full-length novel of Nobel Prize for Literature proportions. As the footnote in the PIC/S guide says, it is a summary with cross-references to the documents detailing the actual work.

Writing the Validation Summary Report

The validation summary report brings together all of the documentation collected throughout the life cycle and presents a recommendation for management approval that the system is validated and should be released for operational use. The emphasis is on using a summary report as a rapid and efficient means of presenting results as the detail is contained in the other documentation in the validation package.

The contents of a VSR are shown in Table I. Each of the major phases of the system development life cycle is represented. This is based on Institute of Electrical and Electronic Engineers (IEEE) standard 1012 for validation and verification plans; the major change from the standard is the addition of a section called validation documentation (this can also be called validation package, dossier, or registry); essentially it's the list of all the documents that support the spectrometer validation.

The issue is how to summarize a phase of the life cycle. Here's an illustrative example of how a user requirements specification or system requirements specification could be summarized:

> A System Requirements Specification (SRS) was drafted and revised between September and November 2003; version 1.0 of the document was approved in early December 2003. This specifies the intended functions that the system will undertake as well as the capacities of several functions and system support requirements. Each requirement is uniquely numbered as well as prioritized as either mandatory or desirable.

There would be a cross reference to the validation documentation or document number so that the document could be retrieved easily if required. Some report statements can be longer with more detail. One or two VSRs I have reviewed have been simply a list of documents produced with a release statement. Whatever your approach, it is important to bear in mind who will be reading this document - quality assurance and regulatory inspectors. It could be one of the first documents requested in an inspection and therefore you need to use it to generate regulatory confidence: in my view a shopping list is not the best way to do this. Spend a little more time on the report and a better document will result.

Deviations from Plan. Before you circulate the first draft of the VSR for review, make sure you have gone back to the validation plan and performance qualification test plan and read then thoroughly. The validation plan is documented evidence of intent and the VSR is documented evidence of what was actually done. The performance qualification test plan covers what usually is the greatest portion of the validation effort, the end user testing. The deviations from plan section discusses any departures (planned or unplanned) from what was originally described in the validation or performance qualification test plans along with a discussion of their potential impact on system quality.

For example, the performance qualification test plan might state that you will have a certain number of test scripts to write and execute. During the actual writing of the test scripts, however, you might decide that a single test script would suffice. You then have two options: reissue the performance qualification test plan with the modifications or issue a file note or equivalent that is approved by the system owner and quality assurance that two test scripts will become one. You can use the deviations section in the VSR to noted and discuss this approach. This is a planned deviation that is thought out and still tests the same functions and will not have any impact on the overall validation.

Performance Qualification Test Execution Notes. Lets face it, you are not going to write the performance qualification test scripts perfectly, and there will be test execution notes written up in the course of the execution. Most may not be particularly major; however, the ones that are should be documented and discussed in the VSR.

For example, the following issues, in my view, should be noted in the VSR and discussed:

A manual calculation formula that is used to check a data system calculation is wrong, and is noted and changed during the execution.

A method that was allocated to a test script is not used and another substituted

Test incidents or software anomalies that impact the quality of data generated or operation of the system

Releasing the System. The release statement that the system is operational should be completed by the validation team and signed by the system owner and quality assurance. It is a simple statement that the system is released for use in a GXP environment. However, there may be some strings attached depending on the results from the validation effort. For example, a calculation provided by the system might be mathematically incorrect or the system might state that it is one calculation but the formula actually used is different.Don't laugh! It's actually happened (5). Therefore the system could have caveats for some functions to be under procedural control or not to be used for GXP work. This should be noted in the release statement.

If this issue is resolved later with a service pack or new version of the software, the operational release of the revalidated system can dispense with the constraint.

Going Live! Sit Back and Rest?

You might think all the hard work to validate the system is over now that you have gone live, but you have just finished the easy part of the validation of your spectrometer and its software. The most difficult part of validation is now before you: maintaining the system in a controlled and validated state during the whole of the operational phase - some 5–10 years. We'll start looking at this in the next installment…

References

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