

FAA Configuration Management

Configuration Audits and Assessments

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Training Overview

- Purpose of Configuration Audits
- Types of Configuration Audits
- Guidance For Conducting Configuration Audits
- Configuration Assessments
- Summary



Purpose of Configuration Audits

- **Ensure that the design provides the agreed-to performance**
- **Audits v. Verification**
- **Acquisition Reform**
- **Performance Capability v. Operational Capability**
- **Verify that product quality issues are dealt with appropriately**
- **Required elements for establishing a Product Baseline**



Configuration Audits

- **What is a Functional Configuration Audit ?**
- **What is a Physical Configuration Audit ?**
- **What is the relationship between the two ?**
- **How are Hardware and Software audits different ?**
- **When are they performed ?**
- **Who is responsible for each of them ?**



Functional Configuration Audit

- **Focus on Requirements Flow**
- **Examine “As-Tested” Functional Characteristics**
- **Audit of Verification Test Data**
- **Validate contractors Test Plans**
- **Look for stability and completeness of the design**



Functional Configuration Audit

SOME COMMON WEAK POINTS

- **Configurations of test systems differ from documented baseline**
- **Generic Test Plans that aren't requirements driven.**
- **Test environment for CSCI verification is not representative of baselined HWCI (beware of simulators)**
- **Requirements aren't specific enough**
 - (...nothing you can DO about it, but note it anyway)
- **Defect management process**
 - Total # of Defect Reports (DR)
 - # of Open DRs
 - # of closed DRs
- **Incomplete regression testing**
- **Design reuse, where the existing design has not been fully tested against current requirements.**

Physical Configuration Audit

- **Formal examination of the “As-Built” configuration**
- **Focus on Documentation (despite the name...)**
- **Focus on production support processes and linkages**
 - Manufacturing Instructions
 - Inspection processes
 - Redline process
 - Integrated Logistics Plan
 - Operating & Maintenance Procedures
- **Audit of engineering release and change control system to ascertain that they are adequate to properly control the processing and formal release of engineering changes**



Physical Configuration Audit

SOME COMMON WEAK POINTS

- **How many different product databases are maintained by support functions? How are they linked?**
- **What's documented vs. what's listed on (current/planned) purchase orders?**
- **What changes are in the pipeline?**
- **Design & Build & Operate & Maintain Contracts**
 - Exactly HOW are we saving money...?

Types of Configuration Audits

- **What is the relationship between a Functional Configuration Audit and a Physical Configuration Audit ?**
 - Design must “**Pass**” the FCA before completing the PCA
 - PCA needs to be conducted on the same system that passed the FCA. Watch for design changes processed after the FCA.

Types of Configuration Audits

- **When are they performed?**
 - One vs. Many
 - Unit Testing of Software is commonplace
 - Software FCA completed before integration with Hardware
 - The software PCA may be delayed until integration testing has been completed
 - Incremental hardware PCAs typically go hand-in-hand with assembly or test sequences

Types of Configuration Audits

- **Primary Responsibility for FCA and PCA?**
 - FCA
 - Government / Government Witness
 - PCA
 - Contractor in Performance Based Acquisition
 - Government in Specification Based Acquisition

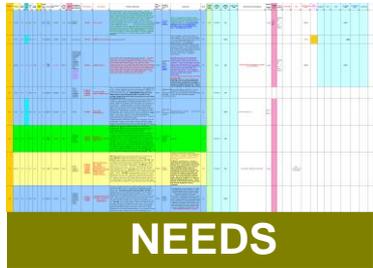
Guidance for Conducting Audits

Functional Configuration Audit

- The FCA is a formal examination of the "***as-tested***" functional characteristics of a configuration item (CI).
- The FCA must verify that the CI has achieved the requirements specified in its ***Functional Baseline*** documentation, and to identify and record any discrepancies.
- Verify the compatibility/completeness of requirements and specification versus test procedures/plans/results and analyses.

Guidance for Conducting Audits

Functional Configuration Audit

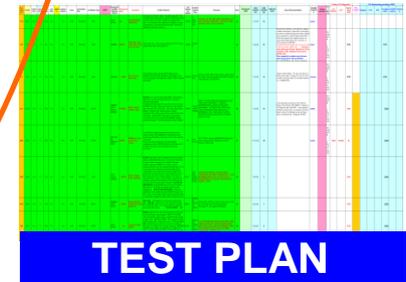


**WORK BACKWARDS
FROM RESULTS TO
REQUIREMENTS**



REQUIREMENTS

FUNCTIONAL SPEC



Guidance for Conducting Audits

Software FCA

- The Software FCA is an examination of individual software unit test results compared against performance specifications.
- The Software FCA is conducted by government personnel at the contractor's plant prior to the hardware/software integration phase.
- The software FCA requires engineering personnel skilled in the particular language(s) being used on the project as well as familiarity with the governing specifications and standards imposed by the contract.

Guidance for Conducting Audits

Hardware FCA

- The hardware FCA is an examination of the test procedures and test results used to perform testing of the total integrated system (hardware and software) against the specifications and the contract statement of work.
- The hardware FCA is a prerequisite for the hardware PCA and is conducted by government personnel at the contractor's plant for new acquisitions and at the installed site for modification projects.
- A hardware FCA requires engineering personnel knowledgeable of testing techniques, equipment and governing specifications and standards.

Guidance for Conducting Audits

Information Needed Prior to FCA

- Approved performance specification and draft design specification (e.g. approved development specification and draft of design specification).
- A current listing of all non-conformances (e.g. deviations, waivers, etc) either approved or requested.
- Test plans/procedures and available acceptance test plans/procedures.
- A complete list of successfully accomplished functional tests during which pre-acceptance data was recorded.
- A complete list of functional tests even if detailed test data are not recorded.

Guidance for Conducting Audits

Information Needed Prior to FCA (cont.)

- A complete list of functional tests required by the specification but not yet performed (to be performed as a subsystem or system test).
- Test reports (Validated data).
- A list of tests, which failed and action items generated from this data.
- Drawings to identify items to be audited, to include:
 - Nomenclature
 - Specification identification number
 - Configuration identifier
 - Serial number(s)
 - Assembly/computer program/software identification numbers

Guidance for Conducting Audits

Information Needed Prior to FCA (cont.)

- Preliminary Design Review (PDR) and/or Critical Design Review (CDR) minutes and action items for closure and items requiring further checks and/or verification.
- A review of the interface requirements and the testing of these requirements for each CSCI.
- A review of database characteristics, storage allocation data and timing, and sequencing characteristics for compliance with specified requirements.

Guidance for Conducting Audits

Physical Configuration Audit

- The PCA is the formal examination of the "as-built" configuration of a configuration item (hardware and software) against its technical documentation.
- The PCA normally includes a detailed audit of engineering drawings, specifications, and technical data (including COTS documentation).

Guidance for Conducting Audits

Physical Configuration Audit (cont.)

- The PCA also includes an audit of the contractor's engineering release and change control system to ensure that they are adequate to properly control the processing and formal release of engineering changes.
- After successful completion of the PCA and the establishment of a Product Base Line (PBL), all subsequent changes are processed by formal change management.

Guidance for Conducting Audits

Software PCA

- The Software PCA is an examination of the as-coded total system software against its design or deliverable documentation.
- For custom software this involves comparison of source code documents with actual coding on applicable media.
- For Commercial Off-The-Shelf (COTS) software this involves verification of correct documentation to support use of the software versions actually being delivered on the applicable media.

Guidance for Conducting Audits

Software PCA (cont.)

- Adequacy of identification and marking of all deliverable software media in accordance with contract requirements or best commercial practice is included in the PCA.
- Personnel conducting a software PCA should be engineers skilled in applicable software languages and conventions for documenting and utilizing software products and possess a familiarity with applicable specifications and standards.
- The software PCA is normally conducted by government personnel after Government Final Inspection, as soon as all final software corrective actions have been implemented.

Guidance for Conducting Audits

Software PCA (cont.)

- If the software is to be run on any equipment other than a COTS mainframe, minicomputer, or microcomputer, the Physical Configuration Audit shall also include a review of all drawings, specifications, technical data, and test data associated with the system hardware.
- This examination shall establish the system hardware baseline associated with the software baseline.

Guidance for Conducting Audits

Hardware PCA

- The Hardware PCA is an examination of the as built system against its design documentation.
- A prerequisite for the PCA is the successful completion of an FCA.
- Non-deliverable documentation used for the PCA may be in contractor format while deliverable documentation should be examined for compliance with contract specifications. Preliminary Operation and Maintenance manuals and red lined preliminary engineering drawings may be used when appropriate.

Guidance for Conducting Audits

Hardware PCA (cont.)

- The hardware PCA is conducted jointly by the contractor and the government at the contractor's plant prior to shipment for new system acquisitions.
- For modification efforts that occur on site the PCA shall be conducted prior to completion of Government Final Inspection.
- Personnel conducting a hardware PCA should be thoroughly familiar with drawing practices, identification and marking specifications, fabrication standards, materials, processes and standard industry practices associated with the system acquisition.

Guidance for Conducting Audits

Hardware PCA (cont.)

- The contractor shall identify any difference between the physical configurations of the selected production unit and the Development Unit(s) used for the FCA and shall certify or demonstrate to the Government that these differences do not degrade the functional characteristics of the selected units.
- The hardware PCA may be conducted incrementally when the contract involves a large system.

Guidance for Conducting Audits

Hardware PCA (cont.)

- Although the first article of a series is normally the only one scheduled for PCA, follow-on units may also be scheduled for PCA if a high confidence level in configuration compliance is required or if subsequent deliveries are site peculiar, relative to installation.



Guidance for Conducting Audits

Hardware PCA

- **Drawing and Manufacturing Instruction Review**
 - A representative number of drawings and manufacturing instruction sheets (MIS) for each HWCI shall be reviewed.
 - Minimum information to be recorded for each drawing reviewed: Drawing Number / Title / Rev, Approval Date, Discrepancies / Comments / Redlines
 - Check each drawing and associated MIS for consistency, all relevant details must match.
 - Review drawing and associated MIS to verify that all approved changes have been incorporated into the documents.
 - Check the drawings of a major assembly/black box of the system for continuity from top drawing down to piece-part drawing.

Guidance for Conducting Audits

Configuration Control Process - PCA

- **Audit engineering release and change control system**
 - A release record is required for each drawing or document
 - Engineering data shall be released through a central authority
 - The release function and documents shall be capable of determining the:
 - Composition of any part in terms of subordinate part numbers
 - Next higher level assembly using any part number
 - Changes which have been partially or completely released
 - Changes released for production incorporation
 - Configuration item, Serial number, or Date effectivity of any change
 - Standard specification number or standard part numbers used within any non-standard part number
 - Specification documents and specification control numbers associated with any part number

Guidance for Conducting Audits

Configuration Control Process – PCA (cont.)

■ Audit Logistics Interface

- Review Logistics data for adequacy, completeness and compatibility with CI configuration.
 - Review Logistics Support planning documents, plans, lists (e.g. provisioned or to be provisioned).
 - Are manuals/training documentation/data acceptable?
 - Review long lead-time items.
 - Are all long lead or provisioned items acquired before PCA of current configuration?
 - Are interim releases of spares of the current configuration? (Do change/release control methods control this?)
 - Review data of parts/assemblies to be provisioned for adequacy.

Guidance for Conducting Audits

Preliminary PCA

- A Preliminary PCA may be conducted by the government, typically at the Critical Design Review time frame.
- Review:
 - Reference designator number assignment plans
 - Drawing/parts list expectations
 - Contract specifications relative to the total hardware system
 - Part identification and markings
 - In-process inspections
 - Contractor's CM/QA program.

Guidance for Conducting Audits

Information Required for PCA

- The PCA cannot be performed unless data for the configuration item being audited is provided to the PCA team. The contractor shall compile and make the following information available for ready reference:
 - Current approved issue of Hardware Development Specification, Software Requirements Specification, and Interface Requirements Specifications.
 - All approved and pending specification change notices
 - All approved and pending deviations/ waivers.
 - A list detailing both approved and outstanding changes against the configuration item.
 - A complete shortage list.
 - Acceptance test procedures and associated test data.

Guidance for Conducting Audits

Information Required for PCA (cont.)

- ...information available for ready reference:
 - Software Programmer's Manuals (SPMs)
 - Software User's Manuals (SUMs)
 - Computer System Operator's Manual (CSOM)
 - Computer System Diagnostic Manual (CSDM)
 - Firmware Support Manual (FSM).
 - Software Version Description Document.

Guidance for Conducting Audits

Information Required for PCA (cont.)

- ...information available for ready reference:
 - A complete engineering drawing index including revision letters.
 - All approved drawings and documents by the top drawing number as identified in the configuration item product specification. All drawings shall be of the category and form specified in the contract.
 - Operating, maintenance, and illustrated parts breakdown manuals.
 - Manufacturing instruction sheets for all HWCI identified by the contracting agency.
 - FCA minutes for each configuration item.
 - Findings/Status of all Quality Assurance Programs in use
 - Approved nomenclature and nameplates.

Guidance for Conducting Audits

Information Required for PCA (cont.)

- The contractor shall provide identification of items to be accepted by at least one of the following:
 - Nomenclature
 - Specification Identification Number
 - Configuration item Identifiers
 - Serial Numbers
 - Drawing and Part Numbers
 - Identification Numbers
 - Code Identification Numbers
 - Software inventory numbering system

Guidance for Conducting Audits

Planning

- Acquisition strategy for System / CI is the basis for audit plans
- Determine level, at which CIs will be acquired, to performance or detail design requirements
- Global plan & schedule for all FCA and PCA activities are to be part of the CM plan
- PCA is undertaken on first articles of product (operational) configuration
- CIs subject to customer control are to be designated

Guidance for Conducting Audits

Preparing

- Prior to the actual PCA, there are several areas for the Audit Team to review, for a smooth audit process:
 - Define composition of review team: customer, contractor, and subcontractor; and assign their functions in the review.
 - List all documentation and reference material to be reviewed. Consider administrative and security requirements
 - Review system level reference designator assignments. Select all CIs and specific lower level units to be reviewed and make initial team assignments.

Guidance for Conducting Audits

Preparing (cont.)

- Prior to the actual PCA, there are several areas for the Audit Team to review, for a smooth audit process:
 - Assemble audit team and inform them of upcoming responsibilities. Discussions with team members of CI assignments could lead to revisions of assignments.
 - Provide detail information pertinent to the PCA; e.g., team requirements, facility requirements, administrative information, and security requirements.

Guidance for Conducting Audits

Preparing (cont.)

- Prior to the actual PCA, there are several areas for the Audit Team to review, for a smooth audit process:
 - Review Configuration Control system. If documentation is available, a thorough knowledge of the contractor CM system now will save valuable time during the PCA.
 - Provide copies of PCA checklists to each team member.

Guidance for Conducting Audits

Preparing (cont.)

- PCA Kickoff Meeting.
 - A PCA Kickoff Meeting should be conducted to establish a mutual understanding of PCA requirements between Government and Contractor personnel. A sample checklist of items is provided here:

Guidance for Conducting Audits

Preparing (cont.)

- PCA Kickoff Meeting.
 - Ground rules for disassembly of any hardware
 - (in most cases, contractor will perform disassembly tasks).
 - Review results of FCA.
 - Review shortages/deviations/waivers.
 - Review change management status.
 - Establish sub-teams and assign areas for PCA.
 - Establish Deficiency Report (DR) rules, numbering.
 - Establish schedule for daily meeting.

Guidance for Conducting Audits

Conducting

- **Contractor shall provide:**
 - Facilities for team members to work
 - Personnel to go through the audit exercise with the team members, with access to contractor's expertise or other contractor areas (facilities) or organizations as necessary to obtain resolutions or provide answers.
 - Formal minutes based on mutually agreed-to rough draft provided by the team.

Guidance for Conducting Audits

Conducting (cont.)

- **Suggested disciplines required for each group:**
 - Audit Co-Chairperson:
 - Configuration Management

 - Design Specifications and Test Data Review:
 - Hardware Program Manager
 - Software Program Manager
 - Hardware Responsible Engineer
 - Software Responsible Engineer
 - Hardware Quality Assurance
 - Software Quality Assurance
 - Hardware Configuration Management
 - Software Configuration Management

Guidance for Conducting Audits

Conducting (cont.)

- **Suggested disciplines required for each group:**
 - Logistics/Technical Specialties (includes Safety, Human Factors, Reliability, Equipment Qualification):
 - Specialty Engineer
 - Logistics
 - Quality Assurance
 - Configuration Management

Guidance for Conducting Audits

Conducting (cont.)

- **Suggested disciplines required for each group:**
 - Drawings and Associated Documentation Control Records:
 - Program Management
 - Responsible Engineer
 - Configuration Management

Guidance for Conducting Audits

Documenting

- Certification sheets similar to examples in EIA-649 will be completed for the entire audit, plus a comprehensive listing of any action items generated as part of the audit.
- Assure that the minutes include the disclaimer of any authority to change the contract.

Guidance for Conducting Audits

Documenting (cont.)

- Upon completion of the audit, minutes will be prepared and distributed to the chairperson. Minutes prepared in final format will be signed by both the government and contractor representatives and delivered to the government in accordance with the Contract Data Requirements List.



Guidance for Conducting Audits

Documenting (cont.)

- Official audit minutes to include:
 - Time, place, purpose, participants, etc
 - All actions and unresolved items agreed to
 - Applicable configuration certifications documenting key audit activities such as:
 - Specific items, systems, documents or processes reviewed
 - Summary of discrepancies / deficiencies of each area in order to control the number of similar findings and observations
 - Definitive statements about acceptability or non-acceptability
 - Final status of the contractor's effort in the area being configuration certified

Guidance for Conducting Audits

Follow Up

- PCA Close-out Meeting. Following the review of all hardware/documentation, a final meeting of the PCA team should be convened. A sample of items to be covered:
 - Review all Deficiency Reports (DR) written by PCA Team.
 - Establish schedule for Deficiency Report work-offs.
 - Establish ground rules for Deficiency Report signoffs.
 - Instruct contractor on submission of minutes and post-audit report.
 - Instruct contractor on submission of final audit report.
 - If PCA is unacceptable (Judgment Call), arrange for re-audit.

CM Assessments

- **What is a Configuration Management Assessment?**
- **How is it different from a Configuration Audit?**

CM Assessments

- **A CM Assessment is focused on PROCESS.**
- **A CM Assessment goes beyond artifacts and looks behind the scenes.**
- **A CM Assessment can be used internally or at contractors/suppliers to ensure compliance with contract provisions and established policies and procedures.**

CM Assessments

- **CM Assessments frequently uncover procedures that are foreign to the assessors, causing confusion and concern. Have an open mind and focus on how the procedure achieves compliance to established policy.**



CM Assessments

- **CM Assessments are usually conducted by independent, senior CM practitioners with a wide and varied background. On the flip side, participating in assessments is an excellent way to gain a broader understanding of CM. Consequently, a mix of senior and junior team members is recommended for most assessments.**

CM Assessments

- **Objectives of CM assessments are:**
 - Ensure that CM policies are understood and being implemented
 - Verify that CM procedures exist and are adequate to comply with policies and contract requirements.
 - Ascertain that the staff is familiar with procedures they should be working to, and verify that they are following them

CM Assessments

- **Objectives of CM assessments are (cont.):**
 - Identify non-conformances and their effect on hardware and software products
 - Assign corrective actions to specific organizations and persons
 - Assure that corrective actions are taken and mitigation plans are in place to avoid future non-conformances

CM Assessments

- **Major topics for CM assessments :**
 - Organizational set up
 - Departmental interfaces
 - External interfaces
 - Policies, plans and procedures
 - Configuration Identification
 - Preparation of configuration documentation

CM Assessments

- **Major topics for CM assessments (cont.):**
 - Drawing maintenance
 - Specification / document maintenance
 - CAD and text file library and release
 - Software library, repository and release

CM Assessments

- **Major topics for CM assessments (cont.):**
 - Configuration Control
 - Initiation of changes (and deviations)
 - Preparing change requests / proposals
 - Evaluating changes
 - Promoting changes
 - Approving changes
 - Change release
 - Change implementation

CM Assessments

- **Major topics for CM assessments (cont.):**
 - Processing non-conformances (waiver)
 - Authorization for non-conformances
 - Configuration status accounting and reporting
 - During development
 - During production
 - For in-service modifications



CM Assessments

- **Major topics for CM assessments (cont.):**
 - Training
 - In-house staff training
 - Subcontractor / supplier familiarization
 - Customer staff support



References

- **MIL – HDBK – 61A:** CONFIGURATION MANAGEMENT GUIDANCE
- **MIL – STD – 1521B (USAF):** MILITARY STANDARD TECHNICAL REVIEWS AND AUDITS FOR SYSTEMS, EQUIPMENTS, AND COMPUTER SOFTWARE
- **ANSI/EIA – 649:** NATIONAL CONSENSUS STANDARD FOR CONFIGURATION MANAGEMENT