MWI 5330.2
REVISION A
EFFECTIVE DATE: August 20, 1999
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MARSHALL WORK INSTRUCTION

QS01

NASA ENGINEERING AND QUALITY AUDIT (NEQA)

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DOCUMENT HISTORY LOG

Status (Baseline/ Revision/ Canceled)	Document Revision	Effective Date	Description
Baseline		5/14/99	Document converted from MSFC-P06.1-C10 to a Directive. Previous history retained in system as part of canceled or superseded ISO Document files. The sample forms (formerly Appendix B) and all references to Appendix B were deleted.
Revision	A	8/20/99	Document updated to reflect new MSFC reorganization.

1. PURPOSE

1.1 To establish policy and specific responsibilities for planning and conducting a NASA Engineering and Quality Audits (NEQA) at contractor facilities and to ensure consistent evaluations of contractor compliance with NASA and MSFC contractual S&MA requirements.

1.2 NASA Engineering and Quality Audits (NEQA) for Office of Space Flight Projects will be structured and completed as defined in this plan. This document establishes requirements for selection, preparation, performance, and closeout of prime contractor, subcontractor, and vendor audits. Methodology and checklists for audit conduct are included in Appendix A.

1.3 This plan is organized to provide necessary guidelines and requirements for the implementation of NEQA at facilities and locations involved in manufacture, assembly, testing, and processing of hardware. This plan provides the methodology for planning, scheduling, performance, reporting and closeout of a NEQA. This audit can provide indicators of generic system anomalies that cause or contribute to the inability of personnel to warrant that the product satisfies specified requirements as well as specific problems in documentation or performance of required manufacturing/assembly operations.

2. APPLICABILITY

This procedure is applicable to all S&MA Office personnel who may serve as survey chairmen or team members on MSFC surveys and to other MSFC organizational elements and in-house MSFC contractors that perform any kind of work involving QA requirements on hardware, software, materials, and process equipment.

3. APPLICABLE DOCUMENTS

None

4. REFERENCES

None

5. DEFINITIONS

None

6. INSTRUCTIONS

6.1 Objective. The overall objective of this plan is to assure that all manufacturing and assembly operations will provide safe and reliable hardware. This requires accurate and readily understood planning and associated documentation, adequate training and certification of operators and inspectors, compliance to formal work authorization documents, and the assurance that the application of an operator's or inspector's stamp is a personal warranty that work performed satisfies the literal requirements of the work documents. The objectives of the audit are to ensure the following:

a. That planning documents correctly reflect the specifications and drawing requirements.

b. Proper levels of controls are in place to establish planning requirements.

c. Appropriate levels of authority are involved in review and approval of planning.

d. Training and certification are adequate to support the required tasks.

e. Planning and instructions are clear, correct, and easily executed and can be verified.

f. Conformance to contract requirements through traceability of the product to engineering specifications and drawings.

g. Disciplined compliance to work authorization documents, specifications, control documents, and other requirements.

h. Inspection stamps provide warranty of satisfactory completion and verification of operations.

i. Adequate controls are in place and properly utilized to assure correct materials and components are delivered from stores to manufacturing floor.

6.2 Responsibilities.

6.2.1 NASA Project Offices or organization responsible for the contract have the primary responsibility to assure implementation of NEQA.

6.2.2 NASA Engineering or other technical organizations have the responsibility to provide technical support to the NEQA through critical assessments of the supplier's engineering processes. In addition, these organizations shall:

a. Provide recommendations for audits where evidence depicts necessity.

b. Assist in scheduling and determining audit scope, depth, and focus by evaluating trend data, metrics, process, product or personnel changes, quality escapes, performance measurement data, etc.

c. Participate as required in audits.

d. Evaluate audit nonconformity for effective and efficient corrective actions.

6.2.3 NASA Safety, Reliability and Quality Assurance (SR&QA) Offices have the responsibility to provide overall quality assurance and safety assessments of supplier's metrics and assist in corrective action evaluations, tracking and closure, and audit scheduling. In addition, SR&QA offices shall:

a. Establish procedure for scheduling, planning, conducting, and reporting audits.

b. Determine need for audit, audit scope, depth, and focus by evaluating trend data, metrics, process, product or personnel changes, quality escapes, performance measurement data, etc.

c. Participate in audits.

d. Evaluate audit nonconformance responses for effective and efficient corrective actions and verify supplier implementation.

e. Retain and safeguard documents pertaining to audit.

6.3 Audits.

The audit can be conducted in one or two phases. Generally, if an audit has not been conducted in a given area, two phases are appropriate. Two phases could also be dictated if metrics or circumstances indicate that systemic or an unusual number of problems exist. Further, the extent of coverage in a Phase I Audit should be determined by incremental results during the progress of the audit.

6.3.1 Phase I Audits (Reference Appendix A).

6.3.1.1 Phase I Actions.

6.3.1.1.1 Plan. Prior to initiation of Phase I investigations, a plan must be established that identifies the product areas to be covered and the method of investigation.

6.3.1.1.2 Personnel Selected. It is absolutely imperative that the personnel performing the investigation be practitioners of the process and that clear, concise guidelines are provided for their use. It is also important that one or two individuals who are knowledgeable of the process, but are non-owners of the process, be included.

6.3.1.1.3 Team Size. Team(s) should not exceed six to eight individuals with all necessary expertise to cover the operation under review. It is recommended that each team select a representative to document and report results of the investigation. Customer representation should be considered.

6.3.1.1.4 A kick-off meeting must occur with each team prior to initiation of the investigation to review the investigation method, operations to be covered, and the reporting criteria. The team members at the kick-off meeting must be clearly chartered to review each operation and the supporting documents with the focus on accuracy and their ability to perform and warrant each task as literally stated. In addition to viewing the tasks for personal warranty, the following items should be included in the guidelines for review:

a. Are drawings, specifications, and planning accurate and consistent?

b. Are operators and inspectors adequately trained?

c. Are the correct parts and quantity required?

d. Are allowable alternate parts clearly defined?

e. Is the full part number identified?

f. Are operation figures adequate?

g. Is the tooling adequate?

h. Are aids or other non-controlled items used?

i. Is the operation sequenced correctly?

j. Is there a preferred sequence for operations allowing out-of-sequence work?

k. Are other documents referenced and is their application consistent with the text?

l. Is this a non-value-added operation or step?

m. Does the text clearly describe what is to be performed?

n. Is serialization entered at the time of installation?

o. Can the mechanic, technician, inspector, or engineer warrant the operation or step as literally stated?

p. Are measurement requirements clear and achievable?

q. Are references to drawings, drawing notes, specifications, procedures, etc., correct and necessary?

6.3.1.1.5 Documentation of Findings. The team(s) will redline documents with proposed changes and corrections.

6.3.1.2 Phase I Element Selection.

6.3.1.2.1 The intent of the Phase I investigation is for the supplier-formed team to conduct a candid self-assessment of their work. This assessment will establish a baseline to be used in the Phase II evaluation, therefore, it is necessary to adequately cover a significant sampling of work documentation. The preferred method would be to complete all planned operations prior to Phase II; however, it is recognized that, given availability of personnel and other considerations, sampling may be necessary to provide data for evaluation at an earlier time.

6.3.1.2.2 Considerations used in selecting a representative sample are as follows, including relative timing of the tasks and personnel availability.

a. Are a large number of planners involved that would influence the text style and clarity? Samples should include all types of styles.

b. Are tasks or operations performed by a limited number of personnel or are they general application? Samples should include all types of knowledge bases.

c. Are tasks planned differently for different operations, i.e., test vs. fabrication? Samples should include all types of operations.

6.3.1.3 Phase I Reporting.

6.3.1.3.1 Categorization of Findings. The team findings will be reviewed and grouped into the following categories.

a. Category 1: Flight Safety Change

1. Hardware produced using incorrect planning, specifications, and/or drawings with no subsequent inspection, operation, or test to adequately screen a condition resulting in a potential Criticality 1/1 R failure.

2. Processes or operations that are considered non-robust and require the hardware to be returned/reinspected after delivery.

b. Category 2: Changes required prior to the next application of the task/operation.

1. 2A: Hardware produced/processed following correct drawing/specification but the planning is incorrect. Includes concerns for drawing/specification validity.

2. 2B: Hardware produced/processed using correct planning but drawing/specification is incorrect. Includes concerns for planning validity.

3. 2C: Method selected for performing an operation or inspection which provides the best opportunity for assuring product integrity and process performance. Does not include "Better Practice." NOTE: Care must be exercised to avoid identifying a better practice that invokes a change beyond current experience and history.

4. 2D: Any other Category 2 changes, including clarifications of operations and operator/inspector buyoff. Buyoff clarifications - ensure operator/inspector can warranty operation.

c. Category 3: All planning changes other than Categories 1 and 2, which will be incorporated at next opportunity and further process changes requiring further study.

6.3.1.3.2 Incorporation of Recommended Changes. After categorization, the required changes should be incorporated in a

timely manner using existing systems with a final review by the review team prior to approval to assure that all changes satisfy their intent.

6.3.1.3.3 Material Review and Unsatisfactory Condition Reporting. Normal rules for Material Review and Unsatisfactory Condition Reporting will apply to the Category 1, 2A and 2B changes. Provisions should be in place to initiate and process these documents as soon as the investigation teams are confident that the problems are adequately described. Flight rationale and hardware quality rationale must be developed for each Category 1, 2A and 2B item prior to review by the Phase II analysis team.

6.3.2 Phase II Audits (Reference Appendix A).

6.3.2.1 Phase II Actions.

6.3.2.1.1 Plan. Prior to initiation of Phase II analysis, a plan must be established that identifies the individuals and methods.

6.3.2.1.2 Personnel selected for Phase II analysis cannot be the same individuals involved in Phase I investigations. Phase II personnel must include experts in the systems covered by the Phase I investigation, with excellent analytic skills to evaluate and penetrate generic system anomalies for root cause analysis. Both NASA and contractor personnel will be included.

6.3.2.1.3 Team Size. No size restriction constrains the number of personnel used on the analysis team. In fact, a larger, more diverse cross-section is preferred. Customer participation at this level is mandatory in order to provide immediate visibility into any product problems.

6.3.2.1.4 A Kick-Off Meeting must occur prior to initiation of the analysis wherein a Chairman and a Deputy Chairman are identified along with a Recording Secretary for the proceedings. A general discussion of the methods and recording rules will occur. The following are areas to penetrate and understand:

a. Planning Activities

1. Personnel training and experience

2. Release and change process

3. Approvals and checking

4. Planning

5. Complexity level and warranty capability

6. Accuracy of planning, drawings, and specifications

7. Lines of authority, control, and responsibility for planning

b. Personnel

1. Special skills identification and training

2. Experience levels and tenure

3. Propensity to follow planning and warranty elements

c. Hardware Inventory, Controls, and Tooling

1. Kitting methods

2. In-process hardware storage

3. Tooling/test fixture and shop aid controls

d. Manufacturing/Assembly

1. Use of shop practice inconsistent with formal manufacturing planning or use of uncontrolled documented procedures.

2. Level of independence of quality inspectors.

3. Identification of tasks which require special skills and training not currently being provided.

6.3.2.1.5 Phase I Team Presentation. As a minimum, the review process will involve Phase I team presentation to the Phase II analysis team covering all Category 1 and 2 changes, and sufficient sampling of Category 3 changes to develop confidence in the proper classification. Note: A large percentage of policy issues and needs may be identified in the Category 3 which necessitates a sufficient sample size and depth of review. (A preferred method of data presentation is the use of redlined planning copies. This provides the best visibility into the problem and the proposed change; however, it may be necessary to review one-line summaries if there are a large quantity of changes to be reviewed. If one-line summaries are employed, red-line planning copies will be available for the team to use at their discretion.)

6.3.2.1.6 Listings of Generic Findings/Concerns, Actions, and Recommendations will be developed during the process of reviewing the Phase I changes. This information should be distributed to the Phase I team(s), as it is developed, to aid in subsequent reviews and increase awareness.

6.3.2.1.7 Phase II Hardware Audits. The Phase II team will apply the NEQA process to either check the validity of the Phase I red-line activity and/or to investigate other areas not addressed in Phase I to support Phase II analysis. The number of hardware audits is dependent on the sample size determined by the Phase II team to satisfy their objectives. As a minimum, members of the Phase II team and customer representatives will be chartered to review a specific component or process. The hardware audit will initiate from the earliest point in the processing of the component and end at its latest state. The audit process described in Appendix A will be utilized.

6.3.2.2 Phase II Assessment.

6.3.2.2.1 Conclusions. The analysis team will, at the conclusion of reviewing all changes identified by the Phase I team(s) organize the data and identify symptoms of overall system problems. Additional review of systems in question may be required and these areas will be reviewed at this time.

6.3.2.2.2 Additional Review. The analysis team may, at its discretion, identify further sampling or complete re-investigation by the Phase I team(s), if there are concerns for the level of review applied or significant system problems.

6.3.2.2.3 Corrective Action Plan. At the completion of the analysis team assessment, the team is required to establish a corrective action plan, if applicable, with clearly defined criteria for closure and assignment of personnel to assure completion.

6.3.2.3 Phase II Reporting. A final report will be prepared per the guidelines in Appendix A.

7. NOTES

7.1 Background. Among the most critical operations conducted for NASA by contractors are those associated with manufacture, assembly, test, and processing of flight hardware. Until recently, insufficient attention has been given to these operations to assure their effectiveness. No Agency policy

existed to require audits of the operations. In addition, audits, when conducted, tended to be "top down compliance" audits where NASA personnel sampled quality management systems, documents, specifications, plans, and manufacturing procedures to verify contract compliance. The inadequacy of compliance audits was clearly demonstrated when a major supplier manufactured and shipped a safety-critical assembly which did not meet drawing specifications in critical areas. It was discovered that an audit had given commendations to the manufacturing area which produced this defective part (and others) near the time of the audit. A subsequent review revealed major problems which could result in errors. The review, conducted by the supplier and NASA, formed the basis of a new audit procedure which has been implemented at several suppliers with remarkable success. The procedure is being implemented across all Office of Space Flight programs and is referred to as the NASA Engineering and Quality Audit (NEQA).

7.2 Introduction.

7.2.1 The basic concept of the audit is simple. It requires a disciplined and orderly review of the accuracy and application of all processes involved in the operations. The fundamental difference between this audit and a contract compliance audit is that the emphasis is placed on the actual work and associated systems rather than on the existence of systems to confirm contract compliance. The review verifies the accuracy of work documentation and procedures, that operators are rigorously following official procedures and understand them, that operators are adequately trained, and that all supporting systems (e.g. configuration management, inspection, manufacturing, planning, test, material and hardware control, metrology, conformance control, etc.) are in place and functioning as intended. The review should verify that the stamp or signature of an inspector, mechanic, or technician is their personal warranty that the work was performed as specified in official documentation and that all documentation was accurate.

7.2.2 The review which originated this audit process was performed in two phases. In Phase I, the supplier formed teams composed of mechanics, inspectors, technicians, and engineers to conduct the initial review. These teams conducted a candid self-assessment of their work. The people responsible for the work and those who actually perform it are in the best position to identify problems. If properly motivated, they are the key to finding and correcting specific and systemic problems. This unique aspect of the audit process has been credited by observers

as being the most important element in the success of the reviews.

8. SAFETY PRECAUTIONS AND WARNING NOTES

None

9. RECORDS

Audit findings and reports will be maintained by the Safety and Mission Assurance Office for the life of the Shuttle program.

10. PERSONNEL TRAINING AND CERTIFICATION

None

11. FLOW DIAGRAM

See Appendix A.

12. CANCELLATION

MWI 5330.2 dated May 14, 1999

Original Signed by
Carolyn S. Griner

A. G. Stephenson
Director

Appendix NASA Engineering and Quality Audit (NEQA) Process Requirements and Methodology

NASA Engineering and Quality Audit (NEQA) Process Requirements and Methodology

1. Audit Scheduling and Planning

1.1 Hardware selected for an audit may be a major assembly, subassembly, component or individual part, and should be selected prior to the audit or at the opening session of the audit. The following criteria will be considered for hardware selection:

a. Audit objectives including adverse trends

b. Particular process to be evaluated

c. An item that involves several critical processes

d. Hardware availability

e. Items that can be traced from acceptance to receiving inspection including raw material certification

f. Items that allow the audit to evaluate many manufacturing/assembly functions, e.g., fabrication controls, nonconformance reporting, metrology, configuration/change control, etc.

1.2 The S&MA Office, in cooperation with engineering and project organization, will collect and analyze data for scheduling and planning audits and will assign an audit chairman. A contractor or subcontractor will be scheduled for audit periodically or selectively based on data indicating numerous or significant discrepancies, adverse trends, quality escapes, and/or significant changes to the contractor's operation. The project office will notify the contractor at least 15 workdays prior to the audit. The notification letter will include the audit dates and necessary contractor support. Subcontractors or vendor audits will involve the prime contractor. The chairman shall identify the hardware and/or areas to be audited. This will be accomplished by coordination with the project office, engineering organization, and evaluation of problems/trends compiled by S&MA. The chairman is responsible for notifying the contractor whether or not the Phase I self-assessment is required prior to commencing Phase II. Whether both phases of the audit are required will depend upon the circumstances associated with a particular application. However, if a Phase I Audit is not conducted, the Phase II Audit must be constructed to involve the

personnel (technicians, inspectors, etc.) actually performing the work.

1.3 The chairman will approve Phase II team members; matching available expertise to product, process, or area to be reviewed. The team will be made up of Government and contractor personnel. The project or engineering organization shall provide a senior team member and other personnel as appropriate.

1.4 The team will gather and evaluate program requirements and available contractor documents to become familiar with the contractor's system.

2. NASA Engineering Quality Audit (NEQA) Flow is shown on Figures 1 and 2.

3. Audit Performance.

3.1 Phase I Assessments. NEQA requires careful tracking of the part through the manufacturing and assembly process. Physical moves, machining, inspections, and tests, etc., are validated by reviewing documentation, personnel certifications, and governing engineering drawings.

3.1.1 Opening Session.

a. Selection of parts to be reviewed will be made at this meeting, if not previously selected. An effort should be made to select parts which involve a maximum number of manufacturing processes and is near the end of manufacturing. Part numbers and serial numbers of parts selected will be recorded.

b. The audit team will review the manufacturing flow from material receipt to acceptance for the selected parts or systems, and in conjunction with the contractor, determine the scope of the audit.

3.1.2 Part Integrity. If the selected part is new hardware, the audit shall include tracking the selected parts back to raw material purchase/certification. Procedure documents, receiving data, equipment/facility certifications, personnel qualifications and certifications, etc., shall be reviewed. If the selected part(s) is recycled hardware, traceability to raw material may not be achievable during the time constraints of the hardware audit. The audit team and the manufacturer shall determine the

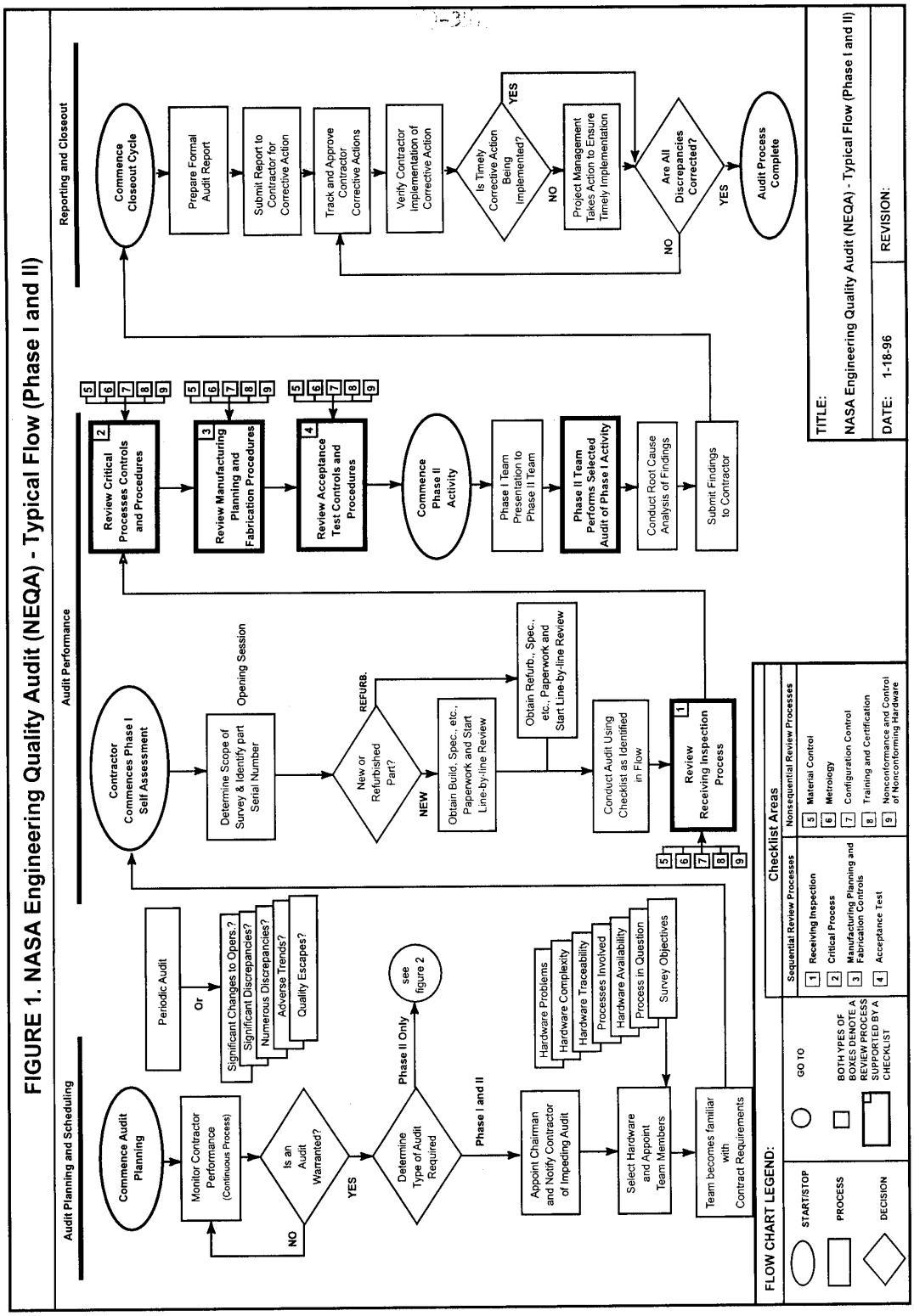
FIGURE 1. NASA Engineering Quality Audit (NEQA) - Typical Flow (Phase I and II)
Audit Planning and Scheduling
Audit Performance
Reporting and Closeout
Commence Audit Planning
Monitor Contractor Performance (Continuous Process)
Is an Audit Warranted?
NO
YES
Periodic Audit
Or
Significant Changes to Opers.?
Significant Discrepancies?
Numerous Discrepancies?
Adverse Trends?
Quality Escapes?
Determine Type of Audit Required
Phase II Only
see figure 2
Phase I and II
Appoint Chairman and Notify Contractor of Impeding Audit
Hardware Problems
Hardware Complexity
Hardware Traceability
Processes Involved
Hardware Availability
Process in Question
Survey Objectives
Select Hardware and Appoint Team Members
Team becomes familiar with Contract Requirements
Contractor Commences Phase I Self Assessment
Determine Scope of Survey & Identify part Serial Number
Opening Session
New or Refurbished Part?
REFURB.
NEW
Obtain Build, Spec., etc., Paperwork and Start Line-by-line Review
Obtain Refurb., Spec., etc., Paperwork and Start Line-by-line Review
Conduct Audit Using Checklist as Identified in Flow
Review Receiving Inspection Process
Review Critical Processes Controls and Procedures
Review Manufacturing Planning and Fabrication Procedures
Review Acceptance Test Controls and Procedures
Commence Phase II Activity
Phase I Team Presentation to Phase II Team
Phase II Team Performs Selected Audit of Phase I Activity
Conduct Root Cause Analysis of Findings
Submit Findings to Contractor
Commence Closeout Cycle
Prepare Formal Audit Report
Submit Report to Contractor for Corrective Action
Track and Approve Contractor Corrective Actions
Verify Contractor Implementation of Corrective Action
Is Timely Corrective Action Being Implemented?
YES
NO
Project Management Takes Action to Ensure Timely Implementation
Are All Discrepancies Corrected?
NO
YES
Audit Process Complete
FLOW CHART LEGEND:
START/STOP
PROCESS
DECISION
GO TO
BOTH TYPES OF BOXES DENOTE A REVIEW PROCESS SUPPORTED BY A CHECKLIST
Checklist Areas
Sequential Review Processes
1 Receiving Inspection
2 Critical Process
3 Manufacturing Planning and Fabrication Controls
4 Acceptance Test
Nonsequential Review Processes
5 Material Control
6 Metrology
7 Configuration Control
8 Training and Certification
9 Nonconformance and Control of Nonconforming Hardware
TITLE:
NASA Engineering Quality Audit (NEQA) - Typical Flow (Phase I and II)
DATE: 1-18-96
REVISION:

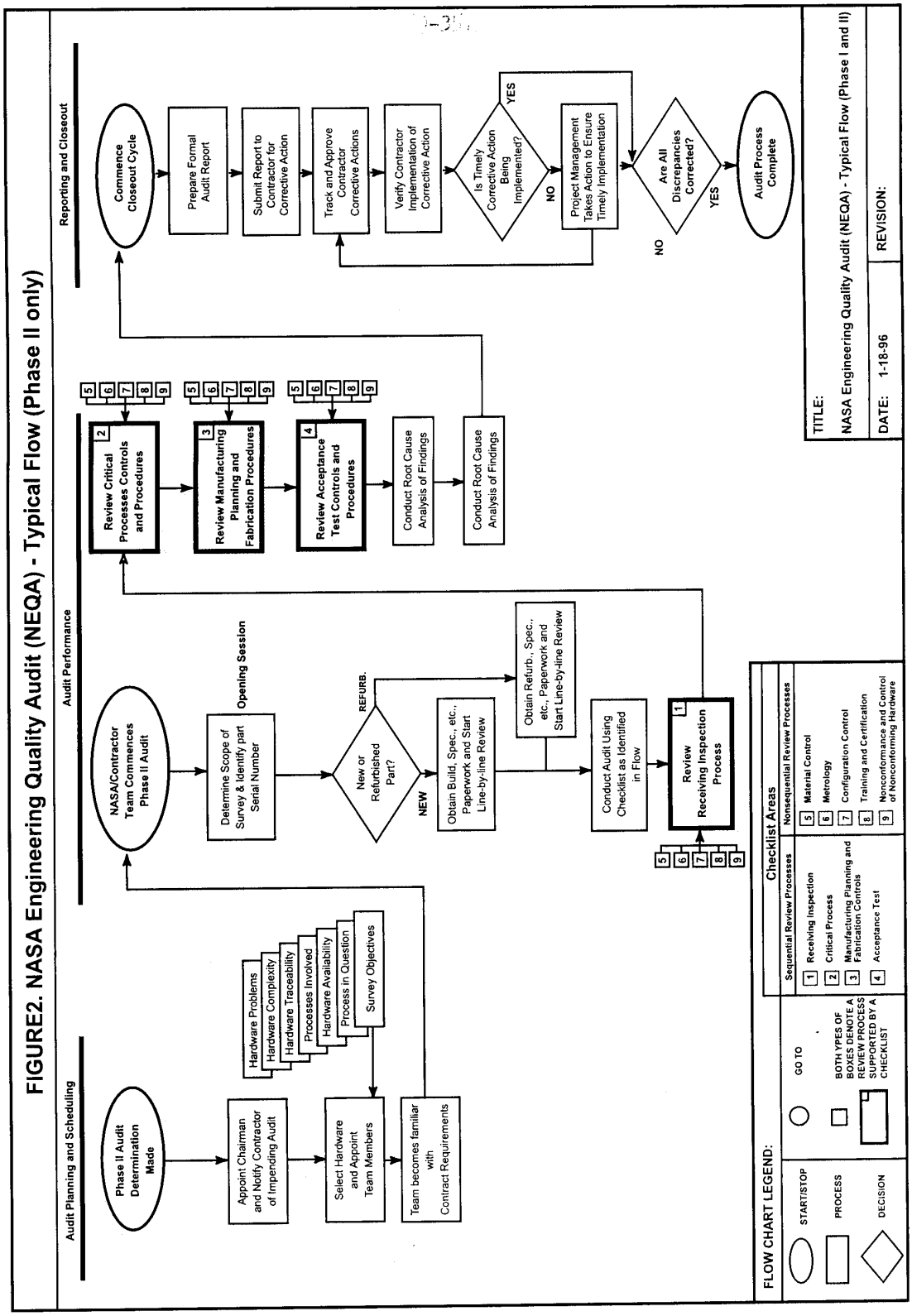
FIGURE2. NASA Engineering Quality Audit (NEQA) - Typical Flow (Phase II only)
Audit Planning and Scheduling
Audit Performance
Reporting and Closeout
Phase II Audit Determination Made
Appoint Chairman and Notify Contractor of Impending Audit
Select Hardware and Appoint Team Members
Team becomes familiar with Contract Requirements
Hardware Problems
Hardware Complexity
Hardware Traceability
Processes Involved
Hardware Availability
Process in Question
Survey Objectives
NASA/Contractor Team Commences Phase II Audit
Opening Session
Determine Scope of Survey & Identify part Serial Number
New or Refurbished Part?
REFURB.
NEW
Obtain Build, Spec., etc., Paperwork and Start Line-by-line Review
Obtain Refurb., Spec., etc., Paperwork and Start Line-by-line Review
Conduct Audit Using Checklist as Identified in Flow
Review Receiving Inspection Process
Review Critical Processes Controls and Procedures
Review Manufacturing Planning and Fabrication Procedures
Review Acceptance Test Controls and Procedures
Conduct Root Cause Analysis of Findings
Conduct Root Cause Analysis of Findings
Commence Closeout Cycle
Prepare Formal Audit Report
Submit Report to Contractor for Corrective Action
Track and Approve Contractor Corrective Actions
Verify Contractor Implementation of Corrective Action
Is Timely Corrective Action Being Implemented?
YES
NO
Project Management Takes Action to Ensure Timely Implementation
Are All Discrepancies Corrected?
YES
NO
Audit Process Complete
TITLE:
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Checklist Areas
Sequential Review Processes
1 Receiving Inspection
2 Critical Process
3 Manufacturing Planning and Fabrication Controls
4 Acceptance Test
Nonsequential Review Processes
5 Material Control
6 Metrology
7 Configuration Control
8 Training and Certification
9 Nonconformance and Control of Nonconforming Hardware
FLOW CHART LEGEND:
START/STOP
PROCESS
DECISION
GO TO
BOTH YPES OF BOXES DENOTE A REVIEW PROCESS SUPPORTED BY A CHECKLIST

boundary of the part integrity portion of the audit and clearly document the limits of the review.

3.1.3 Process Integrity. The audit team must review in detail, line-by-line, the principal work authorization document, specifications, procedures, instructions, control documents, and other requirements being used to control operations on the part or assembly. The objective is to ensure the work is being done in accordance with released engineering documentation. Therefore, all referenced specifications, standards, procedures, drawings, special tools, etc., must be traced to demonstrate that engineering intent was achieved.

3.1.4 Shop Audit. The audit shall include an operational review of the manufacturing area. The audits must locate the selected parts or assemblies and review, line-by-line, all associated shop floor documentation for completeness and accuracy. At this point, the team may broaden the scope of their review to include related hardware being processed, desk-level instructions, and other general inspections.

3.1.5 The audit team members will utilize the NEQA Checklist (see Section 4), included in this document, to conduct the audit. Team members are free to pursue other areas as they deem appropriate.

3.1.6 Findings must be documented. An Audit finding record or other applicable forms may be used. Findings must be classified as follows:

a. Discrepancies - System deficiencies or irregularities found in areas controlled by requirements, specification, or procedures. Discrepancies will be tracked to closure.

b. Observations - Recommendations intended to improve the manufacturing/assembly operations, which are not controlled by requirements. Personnel responsible for the function being reported should be interviewed to provide information needed in determining root causes of the discrepancies. (See Attachment for examples of generic classification and possible root causes).

3.2 Phase II Assessments.

3.2.1 The Phase II Audit will review the work of the Phase Audit (self assessment) and perform a check audit by utilizing the same methods as Phase I, except with a smaller sample of hardware in lieu of an extensive hardware process assessment. If conditions

warrant a Phase II Audit only, this sample assessment should be somewhat larger.

3.2.2 The Audit chairman will provide a copy of all findings to the contractor representative. The findings will be approved by the audit chairman and the project office team member.

3.2.3 Findings recorded as discrepancies will be tracked to closure. Findings recorded as observations will be considered as recommendations intended to improve the manufacturing/assembly operations. Recommendations are provided to the Government Project Office and contractor but not tracked.

3.2.4 An audit finding may be closed during the on-site audit activity if the corrective action can be determined, implemented, and verified. However, finding closeout will usually occur after the site visit.

3.2.5 The Government Project Office, in conjunction with the contractor project office, will be responsible for definition, scheduling, and implementation of corrective action. This responsibility will be assumed immediately after the audit. S&MA will track closure and the team chairman will sign final verification of completed corrective action along with the project manager.

4. NEQA Sequential Checklist.

4.1 Receiving Inspection.

4.1.1 Record the nomenclature and serial number of the selected audit material/hardware.

4.1.2 Compare selected hardware material procurement specification requirements with receiving records to verify compliance with specification requirements.

4.1.3 Verify that the selected material/hardware used in the fabrication of flight hardware is certified and accompanied with certification documentation.

4.1.4 Verify that accompanying material traceability documents for parts/material received by the contractor are complete and correct.

4.1.5 Verify that the selected hardware/material is inspected for proper identification (serial number, lot number, date code, etc.) in the correct manner (etched, stamped, painted, tagged,

etc.) and location as specified in the drawings and procurement specifications.

4.1.6 Physically inspect storage area to ensure segregation of flight hardware from:

a. Nonflight material/hardware

b. Material awaiting inspection and test sample results

c. Accepted and rejected material

4.2 Critical Manufacturing Processes. Identify critical processes selected for evaluation and perform the following:

a. Line-by-line comparison of critical process with process specification and identify potential problem areas.

b. Spot-check interviews with personnel involved with manufacturing of the hardware to determine if requirements of specification are properly understood.

c. Verify procedures are in place for the certification of critical processes and personnel.

d. Evaluate contamination control procedures for selected hardware to ensure compliance with specification requirements.

e. Examine each inspection point for proper placement in the selected critical process sequence.

f. Verify compliance with required inspections by properly certified inspectors.

4.3 Manufacturing Planning and Fabrication Controls. Review the manufacturing planning documentation line-by-line for the selected hardware item and evaluate for compliance with specification. The evaluation should include the following:

a. Verification that the complete data packages are located with the hardware item.

b. Assurance that the item is protected physically and environmentally, as required.

c. Verification that the planning documentation clearly defines the operation to be performed:

1. Sequence of operations

2. Setups

3. Equipment and tools

4. Processes

5. Detailed procedures

6. Drawing numbers and revisions

7. Test operations

8. Specifications

9. Raw materials

10. Environment controls

11. Handling equipment

12. Identification of inspection points

d. Verification that inspection points are properly placed to verify compliance with requirements.

e. Verification that approved inspection work instructions contain as a minimum:

1. Accept/reject criteria

2. Inspection tools, gauges, equipment

3. Drawing number, revision, and nomenclature

4. Workmanship standards

5. Details of specific inspections to be performed

6. Inspection records

7. Control of nonconforming material

f. Verification that the manufacturing planning paper reflects any out-of-sequence operations and that inspection points have not been omitted.

g. Ensure that the manufacturing planning paper reflects the latest engineering changes and that the changes are properly approved.

h. Identification of approved procedures for disposition (marking and segregation) of rejected hardware. Has any material been rejected? If so, is a rejection tag attached to the material? Is the material identified and removed/segregated?

i. Verification that authority to move the hardware to the next manufacturing operation is defined.

j. Verification that workmanship standards are clearly defined.

k. Verify that closeout inspections are performed on items such as black boxes, gear boxes, and equipment containers.

l. Evaluate the contractor's identification and control of temporarily installed equipment.

m. Verify that shipping, packaging and handling are adequate to prevent rust, oxidation, deterioration, and damage.

4.4 Hardware Acceptance Test.

4.4.1 If possible, witness an acceptance test of the selected audit hardware item(s)/or a similar item.

4.4.2 Conduct a line-by-line evaluation of the as-run test procedure and compare with the test plan and appropriate specification.

4.4.3 Verify that test equipment is controlled, maintained, and calibrated as specified in procedures.

4.4.4 Verify that the test environment is controlled to specified requirements.

4.4.5 Verify that nonconformances are properly documented prior to, during, and after testing.

4.4.6 Verify records and data of testing are accurate and in sufficient detail to provide complete verification and evaluation.

4.5 Material and Hardware Control (Nonsequential Checklist).

4.5.1 Verify that the contractor has approved operating procedures for proper control of material stores including government-furnished material.

4.5.2 Compare material specification requirements with storage practices to verify compliance with specification requirements.

4.5.3 Evaluate controls to ensure correct material is delivered from stores to manufacturing floor.

4.5.4 Is there a system for continual identification of material for traceability and data retrieval?

a. Does the ability for data retrieval extend back to the lowest level specified?

b. Does the data retrieval system enable determination of the location of components with identification numbers (serialized, lot numbered, date coded, etc.)?

c. Do the identification methods ensure a unique part or type number for individual articles, lots of articles, or material?

d. Does the identification system preclude re-use of serial numbers of scrapped articles?

e. Are records of articles and materials retained in a safe and accessible location?

4.5.5 Verify that material hardware is properly segregated, e.g.,

a. Material awaiting inspection and test sample results.

b. Acceptable and rejected material.

c. Flight and nonflight material/hardware.

4.5.6 Are age and shelf-life-limited materials/items adequately controlled?

4.5.7 Are Material Utilization Agreements current and properly approved?

4.5.8 Are procedures in place for identifying materials/hardware which have cyclic testing and/or processing limitations? Are applicable personnel familiar with the procedures?

4.5.9 Are limited-use items identified to avoid misuse?

4.6 Metrology.

4.6.1 Are procedures and plans in place for the calibration of measurement standards and equipment?

a. Are calibration standards used traceable to the National Institute of Standards and Technology? Does a review of the certification of each standard reveal calibration within the last year? Are measurement standards uniquely identified and labeled, tagged, or coded to indicate calibration status and due date of next calibration?

b. Is automatic test equipment under scheduled evaluation by the metrology organization?

c. Are procedures adequate and effective for the protection of test equipment during handling and storage (by metrology organization)?

4.6.2 Are all standards and equipment used in measurement processes required to be recalled and recalibrated at established intervals? Does an inspection of test equipment demonstrate that the calibration is current?

a. Are calibration records maintained as required?

b. Are metrology laboratory environmental requirements adhered to?

c. Evaluate the automatic inspection/testing equipment preventive maintenance program.

1. Is the preventive maintenance program documented including adequate schedules and implementing procedures?

2. Does the contractor comply with these documented requirements?

3. Is the equipment thoroughly tested, validated, or certified before putting it back in operation following maintenance?

4. Are the proper tools and consumables available to correctly complete the maintenance actions?

5. Are personnel performing the maintenance adequately trained and knowledgeable of the preventive maintenance procedures and requirements?

4.7 Configuration Control. Verify that proper procedures are in place to implement the contract Configuration Control Plan.

4.7.1 Are change control procedures in place to provide identification of approval authority, establish effectivity, and to provide for timely distribution to organizations responsible for implementation and purge of obsolete documents?

4.7.2 Are all changes incorporated into drawings in a timely manner? Are all copies of drawings properly updated in a timely manner?

4.7.3 Are engineering changes incorporated into planning paper and are shops working to the current planning paper?

4.7.4 Have all deviations from the released design for flight hardware been properly addressed and documented by MRB or waiver/deviation?

4.7.5 Is there an adequate system to verify the “as-built” versus the “as-designed” configuration?

4.7.6 Does a detailed review of the completed data package demonstrate full compliance with contract requirements?

4.8 Training and Certification.

4.8.1 Are critical processes that require certification and training clearly defined?

4.8.2 Does the contractor have a well-defined personnel training and certification plan?

a. Do the personnel have proof of certification for work they are performing?

b. Are recertification requirements defined and is the contractor in compliance?

c. Are accurate records maintained on the training and certification status of personnel?

4.9 Nonconformances and Control of Nonconforming Hardware.

4.9.1 Review documentation used to control nonconforming articles and materials and determine on-the-floor compliance with this documentation.

4.9.2 Select a flight hardware item (selected audit item if possible) in process where nonconformances have been processed and evaluate for the following:

a. Nonconformance paper

b. Dispositions

c. Verification of action taken

d. Re-inspection

e. Corrective action

f. Recurrence control

g. Is/was the hardware requiring disposition adequately controlled (tagged, segregated)?

4.9.3 Are failure trends analyzed for repetitive failure modes?

4.9.4 Select a sample (from selected audit item if possible) of Material Reviews (MRs) and review for:

a. Adequacy of discrepancy description.

b. Is rationale provided to justify dispositions? Is supporting data (stress analysis, lab reports, test data, etc.) referenced on MR or attached?

c. Does disposition address all described defects?

d. Have applicable specifications been called out for the rework?

e. Were sufficient retest requirements identified?

f. Verify concurrence signatures of appropriate personnel.

g. Is the action an appropriate MRB action or should it have been a deviation/waiver?

4.9.5 Evaluate the contractor’s effort to reduce “use as is” MRB discrepancies.

4.9.6 Verify that the contractor has approved standard rework and repair procedures.

4.9.7. Are adequate procedures in place to rework, segregate, or dispose of nonconforming hardware?

4.9.8 Does the contractor have adequate procedures for purging obsolete/nonflight hardware from stores and shop areas?

4.9.9 Are obsolete/nonflight hardware items allowed in shop cabinets, individual tool boxes, or other shop areas?

4.9.10 Can obsolete/nonflight hardware be readily identified without examining part number or serial number?

5.0 Implementation and Verification.

5.1 Report. The audit chairman, with the assistance of the audit team, will prepare a formal audit report. The report will contain, as a minimum, the following:

a. A narrative summary of the audit results (highlighting the significant findings and recommendations for corrections to deficient areas).

b. A summarized count of findings and identification of root causes with appropriate recommendations.

c. A corrective action plan for all actions and findings.

d. A master schedule for correction/implementation of changes, findings, and problems.

Note: The final report shall include (as an Appendix) the entire Phase I report.

5.2 Audit Closeout Procedures. Corrective Actions must be documented. The Government Project Office in conjunction with the contractor project office will be responsible for definition, scheduling, and implementation of corrective action. This responsibility will be assumed immediately after the audit. S&MA will track closure and the team chairman will sign final verification of completed corrective action along with the project manager.

5.3 Examples Of Generic Classification And Possible Root Causes.

5.3.1 Generic Problem: Procedure/Specification Noncompliance - ROOT CAUSES:

a. Personnel did not think requirement necessary.

b. Lack of required effort to do quality job.

c. Personnel not knowledgeable of requirement.

d. Requirement not clear.

e. Human error.

f. Management pressure to meet schedule.

5.3.2 Generic Problem: Inadequate Procedure/Specification - ROOT CAUSES:

a. Lack of detail.

b. Coordination and review inadequate.

c. Specifications do not reflect current requirements.

5.3.3 Generic Problem: Inadequate Management Attention - ROOT CAUSES:

a. Insufficient management visibility.

b. Low priority.

c. Schedule/Resource pressure.

5.3.4 Generic Problem: Inadequate Inspection - ROOT CAUSES:

a. Inadequate Training.

b. Lack of attention to detail.

5.3.5 Generic Problem: Inadequate Manufacturing Planning - ROOT CAUSES:

a. Planner failed to recognize engineering requirements.

b. Human error.

c. Lack of timely update to on-the-floor planning.

5.3.6 Generic Problem: Inadequate Training - ROOT CAUSES:

a. Failure to recognize need.

b. Improper training program.