LIGO Laboratory / LIGO Scientific Collaboration

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LIGO Quality Assurance Plan

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LIGO Scientific Collaboration

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Revision History

Revision	Released By	Pages Affected	Date
00	Mick Flanigan	All	10/08/09
01	Mick Flanigan	All	01/19/10
v2	Jeff Lewis	All	23 April 2013
v3	David Shoemaker	All	24 April 2013
V5	Calum Torrie	All (Change from LIGO to LIGO operations).	26 March 2024

Refer to the **Notes** section of the DCC file card for revision changes.

Refer to the **Signoffs** section of the DCC file card for approvals.

Contents

1 SCOPE

This Quality Assurance Plan is applicable to the development, design, qualification, procurement, acquisition, test, and installation of equipment that together, comprise the LIGO observatories. The provisions of this plan encompass all parts and assemblies including tooling, consumables and services that are used in the development of the LIGO observatories.

2 CONFLICTING REQUIREMENTS

Where there are conflicts between the requirements of this LIGO Quality Assurance Plan and LIGO design documentation or specifications, the provisions of the design documentation or specification shall prevail. Conflicts shall be brought to the attention of the LIGO Quality Assurance Officer and the responsible LIGO Cognizant Engineers for resolution.

3 Quality System

3.1 Introduction

LIGO quality assurance policies, requirements, and activities for the LIGO Project are detailed in this plan. Elements of this plan that require more definition may be supplemented by LIGO quality assurance procedures or quality assurance instructions.

3.2 Policy

The LIGO Quality Assurance group will establish and maintain a program to administer the quality aspects of the LIGO Laboratory.

3.3 Applicability

The provisions of this plan are applicable to all LIGO personnel, contractors/suppliers, students, and collaborating partners participating in the LIGO Project.

3.4 Responsibilities

3.4.1 Responsibilities of LIGO's Quality Assurance

LIGOs head iof Instrument Science and Engineering is delegated the authority and responsibility to accomplish the following:

1. Establish and document the Laboratory quality assurance requirements.
2. Prepare and revise the Quality Assurance Plan.

3. Identify, acquire, and position any equipment that may be required for the implementation of LIGO QA activities.
4. Assist in the acquisition, training, and development of QA personnel to support LIGO quality activities.
5. Prepare task assignments and work instructions where necessary for personnel performing QA functions.
6. Provide QA oversight for LIGO personnel.
7. Manage supplier quality requirements.
8. Participate/support in contract award activities, including proposal evaluation, fact finding, and negotiations.
9. Support Pre-Procurement activities as follows:
    a. Make recommendations to the LIGO Project Leader for the inclusion of quality requirements in the contracts.
    b. Review procurement documentation such as Requests for Quotations and Statements of Work, for the inclusion of appropriate quality requirements.
    c. Review quality assurance plans and other quality documentation submitted by the contractors for approval, prior to release of the contract. Negotiate corrective action where necessary.
    d. Participate in contract negotiations to interpret, clarify, and resolve quality issues.
10. Review contractor/supplier quality assurance plans, processes and procedures.
11. Assure the implementation of adequate quality processes and procedures throughout the LIGO Project.
12. Issue periodic quality status reports to Laboratory management on LIGO QA activities through the weekly LIGO report and NSF Review presentations.
13. Investigate quality problems, develop recommendations for corrective action and provide follow-up on Corrective/Preventive Action Requirements, where appropriate.
14. Identify, review, and report QA related problems that require LIGO Project Leader attention.
15. Concur with the LIGO Chief Engineer or designate regarding discrepant materials that may have an adverse effect on the LIGO ultra-high vacuum system or interferometer function.

16. Monitor the functional control of the configuration and control document release system.
17. Provide assurance that quality records are collected in the LIGO database and maintained as specified by the LIGO Chief Engineer.

3.4.2 Responsibilities of Quality Assurance Representatives

The LIGO Quality Assurance Representatives shall be responsible for the following:

1. Monitoring and auditing quality activities to assure compliance with LIGO approved contractor QA plans, or contractor QA procedures and processes.
2. Auditing contractor's procurement and quality surveillance records to verify the inclusion of LIGO quality requirements into sub-contractor/supplier procurements.
3. Participation in design reviews.
4. Reviewing contractors' Request for Deviation/Corrective Action reports.
5. Providing periodic status reports to LIGO Laboratory management, and science and engineering of progress and/or problems that affect quality.
6. Performing source inspection at the contractor's facility prior to hardware delivery, when necessary.
7. Verifying the content and accuracy of the contractor's End Item Data Package (EIDP).
8. Assist sub-systems in performing verification inspection of purchased (both custom and COTS) parts.
9. Concur with the responsible LIGO science or engineering personnel when in agreement with discrepant material dispositions.
10. Verifying that the handling, packaging and storage requirements of this plan are met.

Additional Responsibilities of LIGO Science and Engineering Personnel

LIGO science and engineering personnel shall be responsible for the following:

1. Providing dispositions of discrepant hardware via the Request for Deviation form Q1100001.
2. Developing handling, packaging and storage procedures.
3. Defining the appropriate QA level for the different phases of Laboratory undertakings
4. Providing resources necessary to implement the requirements established by this quality assurance plan.

3.5 Deviations and Waivers

Deviations from the requirements of this plan shall be authorized by the LIGO Project Leader or his designee with approval by the cognizant technical representative and the LIGO Quality Assurance Officer.

4 Applicable Documents

- M050303 LIGO Project Execution Plan
- Q0900001 LIGO Supplier Quality Requirements
- M1200274 Engineering Change Request (ECR) Process
- Q1100003 LIGO Acceptable Quality Level (AQL)
- M070102 LIGO Change Control Procedure
- M080036 LIGO Project Procurement Guidelines
- E030350 LIGO Drawing Requirements
- M070069 LIGO Project Organization Charts
- C1000266 LIGO Statement of Work Template
- Q1100001 Request for Deviation

5 Organization

5.1 The LIGO Quality Assurance Organization

The LIGO Laboratory quality assurance organization is a responsibility of LIGO's head of System Science and Engineering and the quality assurance representatives. Quality

assurance representatives may be engineering or scientific personnel performing quality assurance functions under the direction of LIGO's head of System Science and Engineering.

6 Quality Assurance Program

6.1 Quality Procedures/Instructions

Requirements and/or procedures for accomplishing complex or critical QA activities to be performed by LIGO personnel will be documented in written procedures and stored on the DCC.

6.2 Design and Development Control

Instrumentation is being developed by the LIGO Laboratory (e.g., R&D and prototype detector elements and subsystems); it is excluded from the LIGO QA requirements established by this Plan unless otherwise directed by the LIGO Project Leader.

6.2.1 Document Controls

The LIGO Project has established a configuration control and release system for the design requirements, drawings, specifications that affect the configuration, interfaces and functional operation of the LIGO observatories. The configuration document control system shall also include provisions for the incorporation of authorized changes to documents issued through the established release system.

6.2.2 Design Reviews

Design reviews for LIGO instrumentation and equipment shall be conducted according to LIGO Project Leader direction/approval. Quality Assurance will participate in design reviews.

6.2.3 Workmanship Standards

Commercial workmanship standards developed/utilized by the contractors will be used for LIGO equipment and facilities. Critical processes necessary for the production of materials and equipment require the identification of acceptance criteria for inspection and test purposes. Where an acceptable product cannot be verified by post process inspection and/or test, definition of in-process controls and/or inspections may be required. Questions regarding workmanship standards requirements for specific processes should be directed to the LIGO Quality Assurance Officer.

6.3 QA Training

LIGO personnel assigned to provide quality assurance support will receive sufficient training to become proficient in the areas necessary to perform any QA operations

required/associated with their task assignments. Training requirements will be determined by the LIGO Quality Assurance Officer, who will also assist in providing the training resources.

6.4 Procurements

Refer to M080036 LIGO Project Procurement Guidelines and Q0900001 LIGO Supplier Quality Requirements for procedures related to procurements.

6.5 Calibration of Inspection and Test Equipment

As a general rule, inspection and test equipment is not required to be subject to scheduled calibration. However, all equipment should be checked for damage and proper function before every use, and any use requiring calibration shall be preceded with a check of calibration to the required accuracy for that measurement.

7 Supplier Quality Requirements

7.1 General

All parts manufactured for LIGO and purchased with a Statement of Work must conform to the requirements of Q0900001 LIGO Supplier Quality Requirements and to the Statement of Work (See C1000266 Statement of Work Template).

7.2 Documentation

Q0900001 LIGO Supplier Quality Requirements and the applicable Statement of Work specify the required documentation to be submitted with each delivery.

7.3 In-vacuum Part Manufacturing Requirements

E0900364 Metal Components For Use in the LIGO Vacuum System documents the specific manufacturing requirements for parts destined for in-vacuum use. All drawings of in-vacuum parts must reference E0900364 in the drawing notes.

7.4 Part and Serial Number Marking

Part and assemblies manufactured for the LIGO interferometers require unique serial number designations that are traceable to their manufacturing batch, as noted in the LIGO Inventory Control System (ICS). All parts must have both the serial number and part number marked on the part, unless the part is too small or not possible for functional reasons, in which case the packaging must be marked with the part and serial numbers.

8 Receiving Process at LIGO Observatory Sites, CIT or MIT

8.1 ICS Entry

Parts and assemblies received must be entered into the Inventory Control System. The End Item Data Package documentation (Vendor inspection reports, material certifications, etc.) is stored in the ICS. (Previously some documents of this type were stored on the DCC.)

8.2 Receiving Inspection

Receiving inspection of part and assemblies delivered for use at the LIGO observatory sites shall include the following:

1. Verification that shipping documentation is complete and accurately reflects the material delivered.
2. Shipping and/or handling damage.
3. A sampling inspection of dimensional or other features for conformance to drawing or other applicable specifications. The amount of inspection may vary based on the criticality and/or manufacturing difficulty of the part.
4. The results of the inspection process are to be noted in the ICS for the batch of parts.

9 Discrepant Materials

9.1 Discrepant Materials at a Vendor's Location

Non-conforming parts discovered while still at the vendor's location should be immediately segregated from known good parts. The Project may allow the vendor to complete LIGO form Q1100001 Request for Deviation.

9.2 Discrepant Materials at a LIGO Location

Non-conforming parts discovered at a LIGO observatory or other LIGO related location should be immediately segregated from known good parts.

9.2.1 Vendor Responsible

The responsible vendor should be contacted if the cause of the non-conformance is their responsibility. The vendor may be invited to complete a Request for Deviation.

9.2.2 Other or Unknown Source of Discrepancy

Other sources of discrepancy can be documented on the Request for Deviation form. Alternatively, any written form of a documented disposition which is stored in the ICS or DCC (LIGO Document Control Center) may be sufficient at the judgment of the QA Officer.

9.3 Discrepant Material Disposition

Typically non-conforming material issues are discussed between QA personnel and the cognizant engineer of the sub-system and a decision is made. The Chief Engineer or designate must approve any discrepancies which violate the requirements of parts used in the ultra-high vacuum system.

Initial discrepant hardware dispositions include the following:

1. Rework to drawing or specification.
2. Repair: Articles that are modified to a useable state but remain nonconforming to drawing or specification requirements.
3. Return to vendor.
4. Use-as-is: Articles that are useable in the present state without further processing.
5. Suspended Action: Articles of which resolution is determined after drawing or specification change, or after hardware fit check.
6. Scrap.

The disposition is written on the Request for Deviation, Technical Direction Memorandum, or other suitable documentation and signed by QA, the cognizant engineer and/or the Chief Engineer or designate.