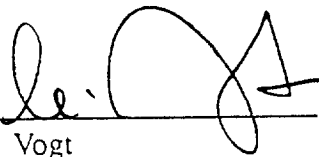


GUIDELINES
for
DETECTOR CONSTRUCTION ACTIVITIES

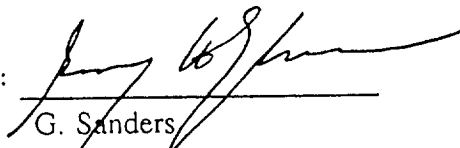
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APPROVED BY:



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GUIDELINES for DETECTOR CONSTRUCTION ACTIVITIES

1. DESIGN REQUIREMENTS PHASE

- *Requirements definition* — Identify and document (in a **Design Requirements Document**) the information necessary to define a particular detector subsystem and quantify its relationship to other subsystems. Typical contents of the Design Requirements Document include:
 - Scope and objectives of subsystem development activities
 - Interface requirements
 - Functional and performance requirements
 - Physical and environmental requirements
 - Documentation requirements
 - Design considerations
 - Testing criteria

Quantification of some items listed in the Design Requirements Document may be deferred until the preliminary design phase. These are listed with values To Be Determined (TBD).

- *Conceptual design* — Generate a conceptual design of the subsystem in sufficient detail to show that the subsystem is completely characterized by the entries in the Design Requirements Document and is understood well enough to proceed with preliminary design.
- Before the Design Requirements Review, the Design Requirements Document is signed off by the subsystem task leader (draft issue).

DESIGN REQUIREMENTS REVIEW (DRR) The Design Requirements Document and conceptual design are presented to a design review board appointed by the Detector Group Leader. Guidelines for the review are outlined in Appendix A. The review board either approves the Design Requirement Document, agreeing that it is complete and sufficient to proceed with preliminary design, or conditionally approves it with recommended modifications (defined by the review board in specific Action Items).

Following the DRR, the Detector Group Leader issues written authorization for proceeding with the Preliminary Design Phase, specifying any changes to be incorporated into the document (by reference to the DRR-recommended Action Items).

2. PRELIMINARY DESIGN PHASE

- Develop the subsystem to the point where *all design issues are resolved*, lacking only the detailed engineering drawings, specifications and contract documents needed for implementation.
- Complete those detailed specifications/engineering drawings needed for long-lead procurements (at the PDR, provide justification to proceed with these items before the Final Design Review).
- Complete the Design Requirements Document by quantifying all “TBD” items and incorporating changes adopted from the DRR.
- Before the Preliminary Design Review, the Design Requirements Document is signed off by the subsystem task leader, the Detector systems engineering task leader, and task leaders of all other affected subsystems.

PRELIMINARY DESIGN REVIEW (PDR) The preliminary design and the completed Design Requirements Document are presented to a design review board appointed by the Detector Group Leader, showing how the design meets all of the identified requirements. The review board either a) approves the preliminary design and Design Requirements Document as presented, or b) recommends changes to be incorporated during the final design phase (defined in specific Action Items).

Following the PDR, the Detector Group Leader issues written authorization for proceeding with final design and long-lead procurements, directing any changes to be incorporated. Changes to the Design Requirements Document are incorporated as soon as possible; it is then signed off by the Detector Group Leader and issued as a controlled document (Rev. A).

3. FINAL DESIGN PHASE

- Generate a final design package, including:
 - Detailed engineering drawings/specifications
 - Detailed procurement specifications/contract documents
 - Detailed inspection plans/procedures
 - Detailed test plans/procedures
 - Detailed integration plans/procedures
- If a prototype was constructed, incorporate results of the Prototype Test Review into final design documentation
- Before the Final Design Review, the final design documents are signed off by the subsystem task leader.

FINAL DESIGN REVIEW (FDR) Present the final design package to a review board appointed by the Detector Group Leader. Show that all issues raised during the PDR have been resolved. The review board either a) approves the final subsystem design or b) recommends changes to be incorporated prior to fabrication (specified as Action Items).

Upon accepting the review board's report, the Detector Group Leader issues written authorization for proceeding with implementation, or directs changes to be incorporated immediately prior to proceeding with fabrication. After Action Items have been incorporated, the final design documents are signed off by the Detector Group Leader and released as controlled documents (Rev. A). Fabrication may not proceed until all Action Items are closed out, final design documents have been approved and released, and written authorization to proceed is issued.

4. PROTOTYPE PHASE (if applicable)

- Develop prototype hardware to the point where all hardware issues are resolved for the final design
- Generate a test report documenting test procedures and results to support details of the final design implementation

PROTOTYPE TEST REVIEW The test report is presented to a review board appointed by the Detector Group Leader, showing that test results meet all design requirements and describing how test results influence the final design. The review board either a) approves the test results and recommends incorporation into the final design documentation, or b) recommends additional tests to be carried out prior to incorporating results into the final design (identified in specific Action Items).

Upon approval of the review board's report, the Detector Group Leader issues written direction to bring the final design to review as planned or to conduct additional testing. The review board's report and responses to the Action Items are presented with the final design documentation at the Final Design Review.

5. FIRST ARTICLE FABRICATION/TEST PHASE (if applicable)

- Produce and test a first-article unit in accordance with the final design documents
- Generate a test report documenting test procedures and results, showing compliance with the final design documents (or proposing changes to the final design documents necessary to achieve compliance)

FIRST ARTICLE TEST REVIEW The first-article test report and any proposed design document changes are presented to a review board appointed by the Detector Group Leader, showing that the first article meets all design requirements and complies with final design documents (or proposed revisions). The review board either a) approves the test results and any proposed design changes, or b) recommends additional tests or design changes, described in specific Action Items, to be carried out and presented for subsequent review.

Upon accepting the review board's report, the Detector Group Leader either a) signs off on approved changes and issues written authorization to proceed with fabrication, or b) directs additional changes to be incorporated, tested and brought before a subsequent first-article test review.

6. FABRICATION/TEST PHASE

- Fabricate and test items as specified in the final design documents
- Document and resolve all discrepancies from approved fabrication drawings/specifications
- Document and resolve all discrepancies from approved inspection and test plans/procedures
- Package the fabricated items for shipment to the remote LIGO sites

PRESHIPMENT REVIEW The fabrication and test records, along with all reports of problems encountered during fabrication and testing and documentation of their resolution, are presented to a review board appointed by the Detector Group Leader. The review board either a) recommends shipment of the items, or b) recommends additional actions to close out open issues (specified as Action Items).

Upon acceptance of the review board's report, the Detector Group Leader issues written authorization for shipment, or directs additional actions to be taken.

APPENDIX A

LIGO DETECTOR TECHNICAL REVIEWS

Detector Group Leader:

- Issue memo (or email) appointing review board, conveying charge, date and location for the review
- Approve review agenda
- Receive review board report and assign action items
- Close out review by delivering a copy of the review archive document (reviewed documents, presentation material, review board report and action item closeout memoranda) to the project document control center

Cognizant Task Leader(s):

- Develop documentation for the review
- Submit proposed review agenda to review board chairman 2 weeks before review
- Ensure that review documents and presentation materials are consistent with the review objectives and agenda
- Distribute review documents to review board members 10 days before review
- Recommend to the Detector Group Leader disposition of recommended action items in the review board report
- Monitor action item status and closeout
- Assemble the review archive document

Review Board Chairman:

- Approve and distribute the review agenda 10 days before review
- Appoint a secretary for the review board (from among members) (to record board comments and action items)
- Conduct the review
- Develop a list of action items
- Generate and distribute the review board report

Review Board members:

- Study the review documents before the review board meeting
- Participate in review board meeting(s)
- Document action items initiated by board member
- Participate in the creation of the review board report