

LIGO Laboratory / LIGO Scientific Collaboration

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<hr/> Change Control Procedure <hr/>		
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Distribution of this document:
Advanced LIGO Team

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of the LIGO Laboratory.

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1 Overview of Change Control

All changes to the Advanced LIGO cost or schedule are controlled in accordance with the Change Control process delineated in this document. This process is used for requesting, reviewing, and documenting changes to the approved Project Baseline. Baseline changes may occur as a result of contractual modifications, application of undistributed budget, assignment of contingency schedule and funds, re-planning, or formal reprogramming. Changes to baseline documents should be minimized and are normally approved only in the interest of significant work scope changes; significant design changes addressing adequacy, reliability, and performance; budget and schedule adjustments that facilitate performance measurement, and all notable safety/environmental considerations.

The purpose of the Change Control process is to assure that:

- The cost, schedule, and technical impacts of the proposed changes are developed and considered by all appropriate and involved parties.
- All relevant evaluations are considered in the approval or rejection of the proposed changes.
- All appropriate parties are informed of proposed changes and their dispositions.
- Baseline documentation is controlled and updated as appropriate to reflect approved changes.
- Action on proposed changes occurs deliberately, but without undue delay and without interfering with project progress.

The stated goals of the Change Control process are:

- To anticipate, recognize, and predict changes to the approved Project Baseline
- To prevent unauthorized or unintended deviations from the approved Project Baseline
- To evaluate and understand the technical, schedule, cost and safety/quality assurance impacts of each change to the approved Project Baseline
- To identify, understand, and control the consequences of changes to the approved Project Baseline
- To ensure each change is evaluated, reviewed, and disposed of at the proper authority level.

Cost/Schedule change request formalities are only required when the cost or schedule changes exceed prescribed levels; see below for details. Project changes as a result of NSF direction, such as a change in funding levels or project level scope, are initiated by the Project Leader/Manager and approved by the NSF before implementation.

Needed changes in the Technical Baseline are brought to the attention of the Technical Review Board (TRB), chaired by the System Engineer. Clearly, there will be cases where both the TRB and the CCB should be notified (or will be triggered) for a single change. In general, the TRB should give its recommendation before that of the CCB, allowing the CCB to make an educated recommendation. Please see the Advanced LIGO Project Execution Plan, LIGO-M050303, for details of the TRB process.

The project Change Control Board (CCB) consists of the Project Leader, the Project Manager, the Project Engineer, the Project Scientist, and the Safety and the Quality Assurance Officers as needed. It also includes any impacted subsystem leaders for each individual change action.

There are two levels of Advanced LIGO Change Requests (ACRs). Level 1 ACR actions deal with changes to contingency levels, project milestones, or scope that impact more than one WBS Level II subsystem. Level 2 change requests include internal adjustments to budget and schedule for a single WBS Level II subsystem that do not change total subsystem budget or impact other subsystem milestones. Level 2 ACRs also include bookkeeping actions and corrections that do not constitute changes to project cost, schedule, scope, or contingency. For Level 1 ACRs, all subsystem leaders are assumed to be potentially impacted and are encouraged to provide comments and feedback that are evaluated for incorporation in the proposed action. For Level 2 changes, only the impacted subsystem leader is included in the review and comment process in addition to the project officers listed above. Approval authority is held by the Project Leader and the Project Manager for both Level 1 and 2 changes. The remaining CCB members serve on an advisory basis. For ACRs that meet certain NSF thresholds, approval by the NSF Program Officer is required in addition to approval by the Project Manager and Project Leader.

2 Requirements for Change Control Actions

2.1 Cost/Schedule/Scope Changes

A Subsystem Leader must initiate a Level 1 Change Control action when any of the following apply:

- 1) A draw on or a give back to project contingency of \$50K or more is anticipated.
- 2) A delay of one month or more in the project NSF reporting milestones results from subsystem schedule changes.
- 3) Proposed changes that involve schedule impacts to other subsystem schedules or involve the transfer of scope and/or budget between subsystems.
- 4) The total subsystem Budget at Completion (BAC) versus Estimate at Completion (EAC) deviates by more than \$250K, unless project management makes a decision to allow the deviation to remain as a variance. Deviations which trigger a required Level 1 Change Control action may be due to a single large change or to the integrated impact of a series of smaller changes.

The Project Manager may initiate a Level 1 Change Control action when any of the following apply:

- 1) The BAC versus EAC deviates by more than \$1M (<1%) for the project as a whole, resulting from a number of individual subsystem variations which do not require change control actions on an individual basis.

A subsystem leader must initiate a Level 2 Change Control action when any of the following apply:

- 1) An internal shift of cost elements between cost accounts is made within a subsystem, even if the outcome is cost neutral to the total subsystem cost.
- 2) The subsystem anticipates missing an internal subsystem control milestone by three months or more, even if no major project milestones are impacted.
- 3) The budget time phasing is revised.

Any team member (in particular the Project Manager) may initiate a Change Control action if they feel there is a Cost or Schedule issue which requires, but has not received, general attention.

2.2 NSF Approval Thresholds

The Advanced LIGO Change Control Procedure includes requirements to obtain NSF approval for baseline revisions that meet certain criteria, per the revisions to the Cooperative Supplemental Agreement PHY0823459 in Amendment #42 (See LIGO-[M1300061](#)).

The Project Manager notifies the NSF Program Officer of all proposed changes or proposed use of contingency prior to project authorization via email or during the weekly teleconferences. After approval, the project Change Request Log is updated, posted in the Document Control Center (DCC), and reported in the monthly and annual project reports.

Prior written approval of the NSF Program Officer is required for the following:

- 1) Configuration changes that affect the overall program baselines for scope, schedule extensions in excess of 30 days, or cost increases in excess of \$250,000
- 2) Requests for use of cost contingency that exceed \$250,000 and/or use of schedule contingency for milestones exceeding 30 days as referenced in the NSF-approved Project Execution Plan.

In the event of emergency situations that require rapid approval (less than 12 hours) of the use of contingency exceeding \$250,000, NSF has provided advance authorization for the use of contingency. The Project Manager shall notify the NSF Program Officer of the change, along with a detailed rationale, within 24 hours of the use of contingency. The rationale shall include a complete description of the situation, cost and impacts and a root cause analysis.

All change requests that meet the criteria above will be sent to NSF for approval after approval by the project manager and project leader.

2.3 Technical Changes

A subsystem leader must initiate a Technical Review Board change request when any of the following apply:

- 1) Any key performance requirements or parameters of the subsystem are proposed to change.

- 2) The baseline design approach upon which the design reviews were based is proposed to change.
- 3) The proposed technical change significantly affects the interface to one or more other subsystems.
- 4) The proposed technical change is judged (by the subsystem personnel) to cause a moderate to significant decrease in the reliability, quality or safety of the system.

3 Change Control Process

3.1 Cost/Schedule Change

3.1.1 Level 1 Change Control

- 1) The first step of the Level 1 Change Control process begins with the generation of a Level 1 Advanced LIGO Change Request (ACR) form (See Appendix 4.1, or DCC document number F0900049-v1). Any project team member can initiate a change to the project schedule and cost baselines by completing the ACR form in electronic format. Any directly impacted Subsystem leader, if not the initiator, must be involved in preparing the ACR form, as must a member of the Project Controls group (ensuring that the cost and schedule figures are coordinated with the Project data).

The Change Description section records the potential or anticipated impacts of the proposed change to the Project Baseline and addresses safety/quality concerns. The impacts of not approving the change should also be included. The assessment should be all-inclusive and thorough to ensure that the consequences of implementing (or not implementing) the proposed change are fully understood. The originating Subsystem Leader will initiate or coordinate inputs to the ACR form and draft a revised Cost Sheet and Cost Account Plan reflecting impacts due to the proposed change. The ACR is then submitted to the Advanced LIGO Project Manager for consideration.

- 2) The Project Manager enters the Change Request into the Change Request Log. Change Requests are numbered sequentially (scheme: FY - sequence #, e.g., 05-001) in order of receipt for tracking purposes. The Change Request Log is updated each time there is a change to the status of a Change Request. When the status of a Change Request is updated, the Project Manager will notify all impacted Subsystem leaders, and send a notice to all members of the project subsystem and intermediate leadership team for informational purposes only.
- 3) The Project Manager adds an initial Recommended Disposition and circulates the ACR to the change originator, project subsystems, and intermediate leaders for review and comments.
- 4) Project Controls staff review the inputs received, request additional information as deemed necessary, and incorporate responses to the comments. Any disagreements with the disposition or requests that are not incorporated will be so noted in the ACR.
- 5) The Originator signs the ACR.

- 6) The Project Manager completes the final Recommended Disposition, and approves by signing the ACR.
- 7) The Project Leader completes the Final Disposition, and approves by signing.
- 8) If the ACR requires NSF approval before implementation, the Project Leader forwards the signed request to the Program Officer for approval and signature.
- 9) Project Controls completes the Project Controls Implementation section, updates the Change Request Log, and places the ACR into the LIGO Documents Control Center (DCC) as Version 1.
- 10) The impacted Subsystem Cognizant Engineers and Scientists acknowledge the approved version of the ACR in the DCC, indicating knowledge and recognition of the approved dispositions and impact on the individual subsystems and project contingency levels.
- 11) Project Controls verifies that all impacted Subsystem Cognizant Engineers and Scientists have acknowledged the approved version of the ACR and signs the ACR as acknowledged in the DCC.

An approved request causes the Project Manager to revise the Project Scope, Cost, and Schedule accordingly. The Project Manager is responsible for revising cost/schedule baseline documents for changes impacting these project baselines.

For any concomitant changes to the project's technical design or scope, the Subsystem Leader is responsible for ensuring the relevant technical documentation is revised to reflect the change in consultation with the System Engineer and any TRB direction on the issue.

Any disapproved Change Request is sent back to Subsystem leader who will consult with the originator to determine any further action.

3.1.2 Level 2 Change Control

- 1) The first step of the Level 2 Change Control process begins with the generation of a Level 2 ACR form (See Appendix 4.2, or DCC document number F0900050-v1). Any project team member can initiate a change to the project schedule and cost baselines by completing the ACR form in electronic format. Any directly impacted Subsystem leader, if not the initiator, must be involved in preparing the ACR form, as must a member of the Project Controls group (ensuring that the cost and schedule figures are coordinated with the Project data). The originating Subsystem Leader will initiate or coordinate inputs to the ACR form and draft a revised Cost Sheet and Cost Account Plan reflecting impacts due to the proposed change. The ACR is then submitted to the Advanced LIGO Project Manager for consideration and approval.
- 2) The Project Manager enters the Change Request into the Change Request Log.
- 3) The Project Manager adds a Recommended Disposition and approves by signing.
- 4) The Project Leader completes the Final Disposition and approves by signing.

- 5) Project Controls completes the Project Controls Implementation section, updates the Change Request Log, and places the ACR into the DCC as Version 1.
- 6) The Originator acknowledges the approved version of the ACR in the DCC.
- 7) Project Controls verifies that the Originator has acknowledged the approved version of the ACR and signs the ACR in the DCC.

An approved request causes the Project Manager to revise the Project Cost and Schedule accordingly. The Project Manager is responsible for revising cost/schedule baseline documents for changes impacting these project baselines.

For any concomitant changes to the project's technical design or scope, the Subsystem Leader is responsible for ensuring the relevant technical documentation is revised to reflect the change in consultation with the System Engineer and any TRB direction on the issue.

Any disapproved Change Request is sent back to Subsystem leader who will consult with the originator for determining any further action.

3.2 Technical Change

Any project personnel can initiate a TRB change request (TRB-CR), with the directly affected Subsystem Leader(s)'s, or the System Engineer's, concurrence. The TRB CR form (see Appendix 4.3) should be completed electronically and submitted with the initiator's and the Subsystem Leader(s)'s or System Engineer's electronic signatures. A key element of the TRB-CR is an indication of whether or not a cost or schedule impact is likely (at the level of magnitude which requires a CCB-CR).

The System Engineer enters the TRB-CR into the TRB Change Request Log. TRB Change Requests are numbered sequentially (scheme: T-Year-sequence#-version#-doc type, e.g., T080001-00-?) in order of receipt for tracking purposes. The Change Request Log is updated each time there is a change to the status of a Change Request. When the status of a Change Request is updated, the System Engineer will notify all impacted Subsystem leaders, and send a notice to all members of the project subsystem and intermediate leadership team for informational purposes only.

The Systems Engineer usually convenes a Technical Review Board with a composition of expertise to address the specific change request. If the impact or magnitude of the proposed change is small, the System Engineer may choose to have the TRB perform an abbreviated review via email, otherwise a meeting(s) is convened to consider the proposal. The initiator is responsible for making whatever supporting information is needed to evaluate the proposal available to the TRB (often in response to TRB questions). Once the discussion has concluded, the TRB members indicate whether they approve or reject the proposal on the TRB-CR form along with their signatures. Usually the TRB also issues a technical memorandum stating the results of their review (unless the TRB review is an abbreviated review.) The TRB's report and completed TRB-CR serve as advice for the System Engineer's decision. The System Engineer indicates his decision on the form, electronically signs, files the completed form in the DCC and notifies all subsystem leaders, as well as the project management, of the disposition of the TRB-CR.

If the TRB-CR is deemed to have technical merit and the TRB-CR form indicates that a cost or schedule impact may be required, then the initiator and the affected subsystem leader(s) are informed that the TRB provisionally approves the CR subject to approval by the CCB. The initiator(s) then pursue the CCB-CR process indicated above.

4 Appendixes: ACR Forms

Copies of the ACR forms are included here for information. Users should go to the LIGO Bulletin Board to obtain the latest versions of these forms before entering information for a change request.

The TRB forms will be added later.

Advanced LIGO Change Control Request – Level 1

Change Request No.: ACR-09XXXX

DCC No: M09XXXX-vX

Change Title:

Date:

Originator:

Impacted Subsystems:

Project Controls Rep:

Signature: _____

Change Description:

If this change requires a Technical Review Board (TRB) decision, check here:

TRB Chair or Project Systems Engineer	<input type="checkbox"/>	<input type="checkbox"/>	TRB report: _____
	Approve	Reject	
Project Leader	<input type="checkbox"/>	<input type="checkbox"/>	Decision memo: _____
	Approve	Reject	

Budget Impact:

Technical changes resulting in a budget impact must be approved by the TRB before review by the CCB.

Schedule Impact:

Technical changes resulting in a schedule impact must be approved by the TRB before review by the CCB.

Advanced LIGO Change Control Request – Level 1

CCR Signature and Disposition Page

Acknowledgement by Impacted Subsystem Leaders: (Acknowledged Electronically in DCC)

1. AOS Subsystem Lead:
2. COC Subsystem Lead:
3. DAQ Subsystem Lead:
4. DCS Subsystem Lead:
5. FMP Subsystem Lead:
6. INS Subsystem Lead:
7. IO Subsystem Lead:
8. ISC Subsystem Lead:
9. PM Subsystem Lead:
10. PSL Subsystem Lead:
11. SEI Subsystem Lead:
12. SUS Subsystem Lead:

1. AOS Subsystem Cognizant Lead:
2. COC Subsystem Cognizant Lead:
3. DAQ Subsystem Cognizant Lead:
4. DCS Subsystem Cognizant Lead:
5. FMP Subsystem Cognizant Lead:
6. INS Subsystem Cognizant Lead:
7. IO Subsystem Cognizant Lead:
8. ISC Subsystem Cognizant Lead:
9. PM Subsystem Cognizant Lead:
10. PSL Subsystem Cognizant Lead:
11. SEI Subsystem Cognizant Lead:
12. SUS Subsystem Cognizant Lead:

Concurrence by Project Management: (Acknowledged Electronically in DCC)

Project Systems Engineer: Dennis Coyne	Project Systems Scientist: Peter Fritschel
Project Quality Assurance: Michael Flanigan	Project Safety Engineer: David Nolting
Project Manager Approval: Carol Wilkinson	Project Manager's Recommended Disposition:
Project Leader Approval: David Shoemaker	Project Leader's Final Disposition:

Project Controls Implementation: (Describe Actions Taken in Cost and Schedule)

Project Controls Staff _____ Implementation Date _____

Advanced LIGO Change Control Request – Level 1

Advanced LIGO Change Control Request – Level 2

Change Request No.: ACR-09XXXX	DCC No: M09XXXXXX-vX
Change Title:	Date:
Originator:	Impacted Subsystems:
	Project Controls Rep:
Signature: Acknowledged in DCC	

Change Description:

Budget Impact:

Schedule Impact:

Concurrence by Project Management: (Acknowledged Electronically in DCC)	
Project Systems Engineer: Dennis Coyne	Project Systems Scientist: Peter Fritschel
Project Manager Approval: Carol Wilkinson	Project Manger’s Recommended Disposition:
Project Leader Approval: David Shoemaker	Project Leader’s Final Disposition:

Project Controls Implementation: (Describe Actions Taken in Cost and Schedule)

Project Controls Staff _____ Implementation Date _____