STAR General Guidelines for Design Reviews

General

Design reviews are an important and integral part of the design process for the STAR detector. The purpose of these reviews is to perform a systematic and objective study of the technical aspects of a specific design. The reviews will be conducted by a team of selected technical specialists, senior engineers, scientific experts, knowledgeable users and experienced management personnel who are not directly associated with the design of the system or component. The reviewers may be members of the STAR collaboration working on other elements of the detector, or may be from outside the STAR project. The work of the design team is carefully examined and evaluated by the selected Design Review Committee to help ensure that the planned design meets its intended purpose and all applicable requirements. Design reviews provide a check to see that no obvious errors were made, and that no significant factors have been overlooked.

While safety is one of several topics to be covered in these reviews, there will likely be separate and specific safety reviews on all major subsystems. These reviews will be the subject of another STAR Note to be written by the STAR Safety Coordinator in conjunction with the RHIC Safety Committee.

STAR Project Policy

It is the policy of the STAR construction project to hold design reviews for all major subsystems. The level of formality of these reviews will be determined by the cognizant subsystem manager with STAR Management consent. Factors to be used in determining the format required include technical risk, cost risk and schedule criticality. These reviews occur at least three times during the design process: at the conclusion of the conceptual, preliminary; and detail design stages. For the STAR detector, the conceptual design review has been completed for all major baseline subsystems. These reviews occurred over a year–long period beginning in December, 1991 with the TPC review. The TAC review of the CDR occurred in August of 1992, STAR internal reviews were held at LBL in November, 1992 and the RHIC/DOE Baseline Cost & Schedule Review took place in January of 1993. The remaining design reviews for STAR will consist of preliminary and final reviews; at least two formal reviews per major subsystem. These reviews are described briefly in the following sections.

These design reviews appear as milestones in each subsystem schedule. It is the responsibility of the cognizant subsystem manager to plan for these reviews and work with STAR management to choose an appropriate review committee and time as well as review and report format.

Definition & Content of Reviews

The Preliminary Design Review (PDR), known also as the intermediate design review, occurs in mid–design when the element definition has been essentially finalized. Here block diagrams, layouts, flow sheets or functional diagrams illustrate the plans and steps already taken. Significant analysis and/or prototype test results are often reviewed at this time. Optionally, intermediate design reviews may be organized to discuss major assemblies or to subdivide the design review into smaller sessions.

The Final Design Review (FDR) is known also as critical or detailed design review. It takes place after the detail design documentation is in order, typically prior to the initiation of the bid or fabrication process.

There is often some overlap in the topics covered in the reviews. In addition, there may be special reviews depending on the nature of the project such as separate design reviews aimed specifically at manufacturability, safety, reliability, a particular key component or subsystem, installation, or other critical issues. Additionally, there may be a need for a supplemental design review as a result of a major design modification.

Topics

The following is a list of topics to be addressed in the design reviews. This section is broken into six subsections: preliminary and final design reviews for Mechanical, Electronics and Software Elements. The topic headings (bulletized) should each be touched upon, the specific items under the topic headings are for further clarification and may or may not apply to each review.

Preliminary Design Review – Topics for Mechanical Elements

- Requirements/scope
    - Function, physics and engineering
    - Subsystem/component requirements
    - Specifications, tolerances, alignment

- Interfaces (physical, structural, utilities, etc.)
    - Global – Interfaces to other subsystems
    - Local – Internal interfaces within subsystem

- Safety issues
    - Personnel
    - Equipment

- Subsystem/components design
    - Technical issues
    - Options considered
    - Proposed approach, pro's & con's
    - How well function, requirements and specifications are met
    - Subsystem/component maintainability

- Analyses and tests to support design configuration
    - Configuration (analyses and physical tests)
    - Input parameters (materials, loads, etc)
    - Boundary conditions
    - Results
    - Safety Factors
    - Critical components and loads

- Fabrication, assembly and test plans
    - Fabrication plans – make or buy
    - Assembly – where and resources required
    - Test – how, where and resources required
    - Quality assurance

- Cost and schedule summary (primarily schedule)

Preliminary Design Review – Topics for Electronics Elements

- Requirements/scope
    - Function, physics and engineering
    - Subsystem/component requirements
    - Specifications (electrical, mechanical, other)

- Interfaces
    - Global – Interfaces to other subsystems
    - Local – Internal interfaces within subsystem

- Safety issues
    - Personnel
    - Equipment

- Subsystem/component design
  - Technical issues
  - Options considered
  - Selected approach, pro's & con's
  - How well function, requirements and specifications are met
  - Testability/maintainability

- Design process
  - Configuration
  - Schematics/data sheets/state diagrams as appropriate
  - Inputs and outputs definition
  - Normal operation/calibration/testing description
  - Special features
  - Results

- Fabrication, assembly and test plans
  - Fabrication plans – make or buy
  - Assembly – where and resources required
  - Test – how, where and resources required
  - Quality assurance

- Cost and schedule summary (primarily schedule)

<u>Preliminary Design Review – Topics for Software Elements</u>

- Requirements/scope
  - Functions, physics and engineering
  - Subsystem/component requirements
  - Operating system, languages, standards

- Interfaces (user, data, APIs, etc.)
  - Local
  - Global (DAQ, slow controls)

- System maintenance and management
  - Configuration management (code management)
  - Subsystem/component maintainability
  - Modification procedures
  - Quality assurance

- Subsystem/component design
  - Technical issues
  - Methodology for detailed design
  - Options considered

Proposed approach, pro's con's
How well functions, requirements and specifications are met

- Data handling
  - Data model, data dictionary
  - Data access, catalog
  - Data storage
  - Data set design

Final Design Review – Topics for Mechanical Elements

- Requirements/scope
  - Function, physics and engineering
  - System and component requirements

- Interfaces (physical, structural, utilities, etc.)
  - Global – Interfaces to other subsystems
  - Local – Internal interfaces within subsystem

- Safety issues
  - Personnel
  - Equipment
  - Safety procedures
  - Safety Analysis Document (SAD)

- Subsystem/components design
  - Technical issues
  - Proposed approach
  - Reasons for selection of proposed approach (especially if different than design presented in PDR)
  - How well function, requirements and specifications are met
  - Testability/maintainability

- Analyses & Tests to support design hardware
  - Configuration (for analyses or physical tests)
  - Input parameters (materials, loads, etc)
  - Boundary conditions
  - Results (tests and analyses)
  - Critical load case summary
  - Resulting Safety Factors
  - Elements which are critical or marginal
  - Failure effects analysis

- Fabrication, assembly and test plans
  - Fabrication plans – make or buy, procurement plan

Assembly and handling tooling/fixturing
Assembly – where and resources required
Test – how, where, procedures and resources required
Subsystem/component maintainability issues, methods
Analyses (structural, thermal analyses in support of equipment & procedures)

- Transportation and handling
  - Transportation and handling fixtures & equipment
  - Lifting and handling procedures
  - Transportation plans
  - Analyses (structural, thermal analyses in support of equipment & procedures)

- Installation & alignment
  - Installation plans
  - Alignment procedure
  - Installation and alignment fixtures & equipment
  - Analyses (structural, thermal analyses in support of equipment & procedures)

- Cost and schedule summary (primarily schedule)

Final Design Review – Topics for Electronics Elements

- Requirements/scope
  - Function, physics and engineering
  - Subsystem and component requirements

- Interfaces (physical, structural, utilities, etc.)
  - Global – Interfaces to other subsystems
  - Local – Internal interfaces within subsystem

- Safety issues
  - Personnel
  - Equipment
  - Safety procedures
  - Safety Analysis Document (SAD)

- Subsystem/components design
  - Technical issues
  - Proposed approach
  - Reasons for selection of proposed approach (especially if different than design presented in PDR)
  - How well specifications are met by proposed system

Testability/maintainability

- Design process
  - Configuration
  - Schematics/data sheets/state diagrams as appropriate
  - Inputs and outputs definition
  - Normal operation/calibration/testing description
  - Special features
  - Results
    - Power & Loading requirements
    - Marginal or critical operational modes
    - Faults and their system impact

- Fabrication, assembly and test plans
  - Fabrication plans – make or buy, procurement plan
  - Tooling/fixturing/specialized test equipment needs
  - Assembly -- where and resources required
  - Test – how, where, procedures and resources required
  - Spares, maintainability
  - Production and QA

- Installation & calibration
  - Installation schedule
  - Calibration procedure
  - Supporting specialized fixtures needed
  - Other (space, power constraints, etc.)

- Cost and schedule summary (primarily schedule)

<u>Final Design Review – Topics for Software Elements</u>

- Requirements/scope
  - Functions, physics and engineering
  - Subsystem/component requirements
  - Operating system, languages, standards

- Interfaces (user, data, APIs, etc.)
  - Local
  - Global (DAQ, slow controls)

- System integration/test (QA)
  - Unit/subsystem acceptance test
  - Integration plan
  - System test/validation

- System maintenance and management
  - Configuration management (code management)
  - Subsystem/component maintainability
  - Modification procedures

- Subsystem/component design
  - Technical issues
  - System architecture
  - Propose implementation technology
  - Reasons for selection of proposed approach (especially if different than design presented in PDR)
  - How well functions, requirements and specifications are met

- Data handling
  - Data model, data dictionary
  - Data access, catalog
  - Data storage
  - Data set design

Action Items

An action item form is often a very useful tool in the design review process. These forms usually contain space for the committee members name and question, the name of the respondent and his/her response, and a sign–off section. An example of a more formal action item form is attached. Committee chairpeople can be given the opportunity to design their own format for these action item forms if they so choose.

Report

A report will be required output from every STAR design review. The formality of the design review report will be determined by STAR subsystem managers with agreement by STAR management based on the aforementioned factors. All major subsystems, or components of subsystems, will in general require a committee report which includes:

a list of the outstanding issues, and
a statement as to the readiness of the effort to move ahead.

Copies of the following should be included as appendices:

the agenda,
the committee membership,
the committee charge, and
all Action Items (resolved and unresolved).