



## **sPHENIX Guidelines for the Conduct of Design Reviews**

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**Author:** Donald R. Lynch

**Date:** 8/24/2018

**Review:** James Min  
sPHENIX Engineering

**Date:** 8/24/18

**Review:** Charles Gortakowski  
sPHENIX QA

**Date:** 8/31/2018

**Review:** Edward J. O'Brien  
sPHENIX Management

**Date:** 8/31/2018

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## INTRODUCTION

This document is intended to establish a framework of groundrules to be used in conducting sPHENIX Project technical design reviews. Coverage includes reviews aimed at small subsystems up to major systems in the sPHENIX program. It is intended to distance these reviews from working sessions that convene scattered contributors with the purpose of resolving technical or Physics problems.

The purpose of this document is to define the different types of design reviews, provide a guideline for the conduct of each type of design review and describe the roles and responsibilities of sPHENIX personnel and collaborators with respect to scheduling, planning and conducting design reviews, documenting the findings of design reviews and addressing the recommendations resulting from design reviews.

This document describes how such need is to be identified, evaluated and addressed for sPHENIX Project Design Reviews.

### 1. Responsibilities

The sPHENIX subsystem Level II Manager (L2) is responsible for incorporating appropriate design reviews in the subsystem schedule, allowing sufficient time to conduct a design review where appropriate and allowing sufficient time to address design review recommendations.

The sPHENIX technical manager, chief engineer and project engineer, jointly or separately, shall appoint appropriately skilled persons within sPHENIX and external to sPHENIX, when appropriate, and assign a design review chairman for each review.

The subsystem L2 manager shall collect appropriate engineering drawings, calculations and any other relevant documentation and provide copies of such documents or access to copies of such documentation, at least one week prior to the design review unless the chairman agrees to a shorter period of time.

All sPHENIX personnel involved in preparing such documents shall be familiar with the requirements of this procedure and shall assist the L2 manager in collecting and disseminating such documents.

### 2. Types of Reviews

### **2.1 Conceptual Design Review (CDR)**

A CDR is a review presented in front of an independent panel, wherein sufficient illustrations, simple calculations and analyses, and related documentation is presented to demonstrate to the reviewers that the design concept for the subsystem is reasonable and meets the required physics goals as outlined in the sPHENIX Conceptual Design Report. Elements presented at the review are conceptual as represented by layouts, 3D models, simple schematics, tooling, fixtures, assembly descriptions and support systems. Initial estimates of Cost and schedule and safety factors are also defended.

### **2.2 Preliminary Design Review (PDR)**

A PDR is a subsystem level review held when the subsystem design concept has coalesced to the extent that the subsystem is ready to proceed towards the final production design and layouts of all subsystem assemblies, subassemblies and components are available, analyses of the subsystem performance, structural integrity, integration with other subsystems, and safe assembly, handling and operation can be defended. Interface Control Documents (“ICD’s”) should be completed and under configuration control. The panel of reviewers will be mostly internal to sPHENIX but should include key independent experts as determined by sPHENIX project management. Elements presented at the review are well understood and ready to be detailed as represented by layouts, 3D models, schematics, tooling, fixtures, assembly procedures and support systems. Safety issues shall be addressed and mitigation plans to manage these issues shall be presented. Cost and schedule should be within budget, but these are generally not presented at the PDR.

### **2.3 Interim Design Review (IDR)**

An IDR is a detail component, subassembly, fixture, tool, equipment or services level review held when the item design concept has matured to the extent that the item is ready to be detailed for procurement. This can be at the prototype, pre-production, or final production stage. Reviewers will be mostly internal to sPHENIX but may include key independent experts if deemed necessary by sPHENIX project management. Detail drawings, layouts, 3D models, schematics, analyses, assembly procedures and integration analyses support systems are to be provided to the extent necessary to demonstrate that the item is ready to be finalized for procurement. Safety, schedule and cost risk analyses as appropriate for the item being reviewed are also included.

### **2.4 Final Design Review (FDR)**

An FDR is a subsystem level review held when the subsystem design is fully understood to the extent that the subsystem design documentation package is ready to be “frozen” for final production. (“frozen” implies that no documentation changes may take place without detailed justification and explicit approval from sPHENIX Project Management and, as required, through the sPHENIX change control process (see sPHENIX

Configuration Management Procedure, document # sP-SE.QAM.003.)

.Design of all subsystem assemblies, subassemblies and components are presented, analyses of the subsystem performance, structural integrity, integration with other subsystems, and safe assembly, handling and operation are to be defended. The panel of reviewers will be internal sPHENIX experts augmented with key independent experts invited by sPHENIX project management. Elements presented at the review are generally final completed documents and analyses but may include some near completed components that are well understood and ready to be detailed. Presentations will also address system and personnel safety, tooling, fixtures, assembly procedures, support systems internal and external integration with layouts, 3D models, schematics, etc. Cost and schedule should be demonstrably within budget, but these are not a primary focus of the FDR.

## **2.5 Production Readiness Review (PRR)**

A PRR is a pre-procurement review of a major components, assembly, fixtures, tool, equipment or service(s) in support of an sPHENIX project subsystem, held to assure that all documentation required for the procurement is complete, accurate and comprehensive, fully describes the item(s) to be procured/fabricated with all tolerances, capabilities, processes and deliverables appropriately specified. Elements presented at the review are generally final and complete. Presentations will also address item design by reference to related design reviews and action items from design reviews satisfied prior to the PRR. PRR reviewers will generally include appropriate internal sPHENIX staff, sPHENIX QA representative, sPHENIX Safety Officer and in some cases, BNL procurement specialist(s).

PRR's in general, also include reviews of sPHENIX production facilities and procedures prior to initiating fabrication, assembly and or installation work at BNL and/or sPHENIX collaborators facilities. The review panel for these PRR's will be assembled by the safety organization for the specific facility (e.g. Physics Department safety group, CAD Experimental Safety Review Committee [ESRC], collaborating institutions safety review organization).

## **2.6 Operational Readiness Review (ORR)**

ORR's are sPHENIX subsystem level and full sPHENIX system level evaluation of the subsystem or full system status with respect to full operations within the RHIC accelerator umbrella and are essentially final safety reviews prior to commencing operations for subsystems and the full sPHENIX system. These reviews shall be conducted by the CA departments Experimental Safety Review Committee (ESRC) to assure that all aspects of the subsystem/full system have been implemented appropriately and to verify it is safe (relative to both personnel and equipment) to operate the subsystem/full system within RHIC operations.

The Review Committee for the ORR shall be set by the CA-D ESRC and chaired by the ESRC Chairman or his designee.

Presentations shall normally include engineering overviews of all safety aspects of the subsystem/full system including structural, electrical, thermal, environmental (gas, radiation, etc.), impact on the existing accelerator safety review envelope, and any safety concerns that are beyond the existing safety issues for the RHIC CA-D complex.

### 3. Precautions

None

## 4. Design Review Description

### 4.1 FREQUENCY

Design reviews shall be conducted at least at intervals specified in the WBS schedules. The following reviews (as described above) are required for each subsystem:

CDR

PDR

FDR

ORR

Additionally IDR'S and/or PRR's are required for all major components and for all production facilities for major components, subassemblies and subsystem assembly. For example where assembly and/or integration of subsystems is to be performed by sPHENIX personnel/collaborators at BNL or at sPHENIX collaborators facilities, a PRR is appropriate.

### 4.2 SCOPE

The level of the design review should be determined in advance so that all participants are working toward the same goal. At the end of the review, the review committee and sPHENIX management will make a final assessment of whether the material presented satisfied the intent of the review (as a function of its content, maturity of the design, completed drawings, tests, analysis etc.) For example, if a review intended to be a final review fails to satisfy the committee that the design is complete and ready for construction or procurement to begin, additional reviews (IDR's) may have to be scheduled. The FDR shall not be considered complete until each of the directed IDR's is complete and all action items closed out.

#### 4.3 REVIEW COMMITTEE

When the cognizant design group requests a design review, sPHENIX management will appoint a committee chairperson, and will designate individuals to sit as members of the review committee. Make-up of the committee may include representatives from sPHENIX management, Quality Assurance, the sPHENIX Collaboration, and Safety and Environmental Protection when appropriate to specific areas of discussion.

The committee may also include members from outside sPHENIX who have related expertise.

The CA-D ESRC chairman as described above shall appoint committees for ORR's.

#### 4.4 REVIEW MATERIALS

The responsible L2 manager is expected to submit the following documentation in a timely fashion for review by the committee (posted on the meeting website):

1. Design Summary--Describing the purpose or objectives of the design, the design requirements, design particulars, and critical parameters.
2. List of supporting documents together with copies i.e. Specifications, Reports, Analyses, Test Plans, Safety concerns and measures, all subject to modification as a function of the level of the review. Types of documents to be submitted may include any or all of the types listed in the following categories as appropriate to the level of review:
3. Draft or released version of Interface Control Documents
4. Action Items with status from previous relevant design reviews.

#### 4.5 QA

The presenters should demonstrate that the QA aspects presented in the review conform to the most current version of the sPHENIX Quality Assurance Plan #sP-SE.QAM.007 and Configuration Management Procedure, document # sP-SE.QAM.003, as appropriate for the review being conducted. In particular, where appropriate the following items might be presented:

- Inspection and Acceptance Plans & Criteria
- Handling and Disposition of Non-Conforming Parts
- Configuration management:



- Change Control Procedures
- Change Documentation
- Chain of Approval

#### 4.6 DRAWINGS & RELEASE STATUS

Drawing List and drawings on the list (including, as appropriate)

- Envelope drawing
- Assembly drawing
- Detail drawings
- Hoisting and Handling and other tooling/fixture drawings

#### 4.7 BASIC AGENDA

Design and readiness reviews will be somewhat different in their approach. Design reviews will concentrate on the design documentation and demonstration that the design will meet all of the requirements for the subsystem/component under review and address engineering safety related issues. Readiness reviews will concentrate on procurement documents, production facilities, safety and operational procedures.

In some cases PRR's may be combined with design reviews, if convenient and appropriate as determined by sPHENIX management,

In all cases ORR's will be separate from design reviews, but 2 or more ORR's may be combined, if deemed convenient and appropriate by sPHENIX management.

##### 4.7.1 Design Reviews

Typical design reviews will include elements of the following agenda or equivalent at a level appropriate for the current phase of development of the project:

1. Present/Define the purpose and level of the Review.
2. General:
  - Define Subject Requirements
  - Present and Explain Design
  - Report on status to date.
  - List progress.

- List drawing release status---Conceptual, Preliminary, Final Design,
- Sign-off status, Release status.

3. Technical Description:

- Describe Selection of Materials
- Describe Fabrication Methods
- where and by whom fabrication will be accomplished.
- Any unique methodology, technology.

4. Discuss Safety Issues.

5. Discuss Documentation

- Drawings (layouts, assemblies, details, schematics, etc.)
- Design Approvals
- Analyses in support of design
- Other

6. Interface/Integration Provisions

- Envelope Drawings
- Outline/Interface Drawings
- Integration Control Documents

**4.7.2 Readiness Reviews**

Readiness reviews include:

- PRR's for procurement of components, tools and fixtures, subassemblies, services
- PRR's for production facilities prior to commencing production
- ORR's for subsystems and the full sPHENIX subsystem,

Typical readiness reviews will include elements of the following agenda or equivalent at a level appropriate for the type of review proposed:

1. Present/Define the purpose and level of the Review.

## 2. General:

- For a procurement PRR, list:
  - items to be procured,
  - documents supporting these items (drawings, design specs)
  - statement of Work
  - required QA provisions.
  - Any other relevant documents (e.g. preferred vendors list, sole source justification)
  
- For a facility PRR, list:
  - items to be produced in the facility,
  - documents supporting these items (drawings, design specs)
  - documents describing the design of the facility (layout drawings and schematics),
  - facility infrastructure requirements.
  - Any other relevant documents
  
- For an ORR, list:
  - equipment items to be reviewed
  - documents supporting these items (drawings, design specs)
  - documents describing the operation of the equipment under review
  - supporting documents which describe the procedures that will control the operation of the equipment
  - Any other relevant documents

## 3. Safety Issue Discussion

Discussion of any relevant safety issues and steps taken to mitigate them.

## 4. Documentation Discussion

- QA
- Procurement drawings/facility layouts

- Other procurement documents (SOW's, Specs, etc.)
- Procedures
- Travelers
- Inspection and acceptance criteria (PRR)
- Procurement Schedule (PRR)
- Other

## 6. Address Hoisting and Handling and Transportation Provisions

### 4.8 REPORT

A summary report will be issued by the Review Committee and will include but not be restricted to, the following:

- Evaluation of the design/documents and its/their maturity relative to expectations.
- Committee assessment of the level of the review.
- Definition of the status of the design complete to the extent that the maturity of the design is clearly identified and may be used to establish where the design was at the time of the review and distinguish any changes that may be made subsequent to the review.
- Lists of any documentation submitted, status and date of issue where pertinent.
- Results of Review
- Any unsatisfactory items and any proposed solutions/remedies
- Action Items/ Recommendations/ Comments

### 4.9 ACTION ITEMS:

An action item shall be defined as any concern or technical issue not adequately addressed by the design or arising as a result of meetings or ongoing discussions, that cannot be resolved when raised by using the expertise of the group present at the review, thereby requiring further study or contacting some source of information external to the group.

The action items should be handled as follows:

- A. The specifics of the action item are defined.
- B. sPHENIX management assigns individual or group responsibility for the resolution of the action item.
- C. sPHENIX management assigns a date by which the action item must be answered to its satisfaction. The date will be assigned consistent with the urgency of the item, and with adequate allowance for the effort needed to respond appropriately and process the response.
- D. sPHENIX management assigns the L2 manager for the subsystem to be responsible for the controlled log/ list of pending action items, the required satisfaction date, the individual/s responsible for resolution of the item, the initiator/s, status, method of resolution and date closed to be entered into the sPHENIX Comment Resolution Database. This record shall be retained for the duration of the project by sPHENIX Management.

#### **4.10 CLOSE OUT OF REVIEW:**

Copies of the Design Review Report will be circulated to attendees and interested parties. Close out of the review will be complete when the outstanding action items have been addressed to the satisfaction of sPHENIX management and the responses documented and placed in project files.

## **5. References**

C-A OPM 02.42 Liaison Engineer, Physicist; Project Engineer and Physicist; Liaison Scientist: Roles and Responsibilities for Modifications

C-A OPM 13.6.2 Configuration Management

C-A OPM 13.3.1 Graded Approach for Quality Requirements

sPHENIX Document # sP-SE.QAM.001\_Procedure Preparation Guidelines

sPHENIX Document # sP-SE.QAM.003 sPHENIX Configuration Management

## **6. Attachments**

Attachment 1: Checklists for Design Reviews

Attachment 2: Questions that should be addressed at each review

Attachment 1: Checklists for Design Reviews  
 A: CDR Checklist

<b>CDR Checklist</b>	
<i>The responsible sub-system L2 manager is expected to submit the following documentation in a timely fashion for review by the committee:</i>	
<input type="checkbox"/> Design Summary	
<input type="checkbox"/> List of Support Documents with Links	
<i>Items to be addressed at CDR:</i>	
<input type="checkbox"/> Physics Requirements for Subsystem	
<input type="checkbox"/> Design Parameters required to Satisfy Physics Requirements	
<input type="checkbox"/> Design Requirements	(Performance, dimensional, environmental, material, power, signal processing, etc. including tolerances in appropriate detail for the design concept)
<input type="checkbox"/> Design Concept	(Initial drawing plan, description of major interfaces, preliminary structural and performance analyses)
<input type="checkbox"/> QA concept	(Basic description of Configuration management, procurement, inspection and acceptance criteria)
<input type="checkbox"/> Assembly Concept	(General description of plausible assembly process)
<input type="checkbox"/> Installation Concept	(General description of plausible installation scheme)
<input type="checkbox"/> Safety Issues	List all potential personnel and equipment safety concerns associated with the design, assembly, testing, installation and operation of the subsystem under review
<input type="checkbox"/> Unresolved Issues and Concerns	List and evaluate issues and concerns not yet fully addressed.
<b>Review Notes</b>	
<b>Recommendations</b>	
<b>Comments</b>	
<b>Action Items</b>	

Attachment 1: Checklists for Design Reviews  
 B: PDR/FDR/IDR  
 Checklist

<b>PDR / FDR / IDR Checklist</b>		<i>(circle one)</i>
<i>The responsible sub-system L2 manager is expected to submit the following documentation in a timely fashion for review by the committee:</i>		
<input type="checkbox"/>	Design Summary	
<input type="checkbox"/>	List of Support Documents with Links, files or hard copies	
<b>Items to be addressed at review:</b>		
<input type="checkbox"/>	PHYSICS Requirements	
<input type="checkbox"/>	Design Parameters	
<input type="checkbox"/>	Design Requirements/Standards	(Performance, dimensional, environmental, material, power, signal processing, etc. including tolerances, in appropriate detail, to be accounted for in the design under review)
<input type="checkbox"/>	Design Details	(Layout drawings, completed detail drawings, electrical, gas, cooling flow schematics in draft form, analyses supporting the design layouts, performance analyses (operational simulations, thermal, electrical, environmental)
<input type="checkbox"/>	QA plan	review)
<input type="checkbox"/>	Assembly Plan	(Draft or early release assembly plan including draft procedures, tooling & fixture descriptions/models)
<input type="checkbox"/>	Installation Plan	(Installation plan including procedures, tooling & fixture descriptions/models)
<input type="checkbox"/>	Safety Issues/Requirements	Address all potential personnel and equipment safety concerns associated with the design, assembly, testing, installation and operation of the subsystem under review as listed at the CDR and any additional safety issues not previously listed.
<input type="checkbox"/>	Unresolved Issues and Concerns	List and evaluate issues and concerns not yet fully addressed.
<b>Review Notes</b>		
<b>Recommendations</b>		
<b>Comments</b>		
<b>Action Items</b>		



Attachment 1: Checklists for Design Reviews  
C: PRR Checklist

<b>PRR Checklist</b>	
	<input type="checkbox"/> Design Summary  <input type="checkbox"/> List of Support Documents with Links
<i>Items to be addressed at PRR:</i>	
<b><u>Documentation Requirements</u></b>	
Drawings	
Other Documentation	
Vendor Information	
Facility Information	
<b>Approval</b>	<input type="checkbox"/>
L2 Manager Approval	<input type="text"/>
L2 Approval Date	<input type="text"/>
<b><u>Committee Members</u></b>	
Member Expertise	
Member Expertise	
Member Expertise	
Member Expertise	
Member Expertise	
Member Expertise	
Member Expertise	

Attachment 1: Checklists for Design Reviews  
D: ORR Checklist

Attachment 2: Questions that should be addressed at each review

## Conceptual Design Review

1. Requirements – Are the requirements for the subsystem established and consistent with the Conceptual Design Report?
2. Engineering and Design – Does the conceptual design address the requirements for this subsystem. Is the concept reasonable and achievable?
3. Management - Is the project and engineering resources adequate to effectively move the subsystem into the next phase of design? Is there adequate time available to move from the Conceptual Design stage into Preliminary Design?
4. Interfaces – Has an acceptable Interface Control Document(s) been drafted for this subsystem. Are the interfaces well understood by the project and design team?

## Preliminary Design Review

1. Requirements – Are the requirements for this subsystem appropriate and well understood by the design team? Are the proposed requirements consistent with those outlined in the Conceptual Design Report?
2. Engineering and Design – Are the mechanical, electronic, and electrical designs appropriate to meet the requirements of sPHENIX and are they mature enough to proceed to final design? Are there any ongoing design related questions that have yet to be addressed? Is further prototype work required and if so, where?
3. Interfaces – Are the main interfaces identified and defined in an sPHENIX Interface Control Document? Is this document in draft or a released status?
4. Management – Is this work correctly described with an adequate number of tasks in the Resource Loaded Schedule? Is it linked appropriately to other subsystems? Are there adequate resources assigned to the design and level 2 project team? Is there an appropriate amount of time designated to achieve final design status?

Attachment 2: Questions that should be addressed at each review (continued)

5. Quality and Acceptance - Is there a basic understanding of the Q/A requirements for major components of this sub-system. Is testing and acceptance criteria been documented and reasonable for the complexity, cost, and schedule impact it has to the overall sPHENIX project plan?
6. Are there any safety related issues that need to be addressed in the design? How are they being met?

### Final Design Review

1. Requirements – Are the requirements for this subsystem appropriate and well understood by the design team? Are the proposed requirements consistent with those outlined in the Conceptual Design Report?
2. Engineering and Design – Are the mechanical, electronic, and electrical designs appropriate to meet the requirements of sPHENIX and are they mature enough to proceed to fabrication and construction? Are there any ongoing design related questions that have yet to be addressed? Have all code/safety requirements been addressed?
3. Interfaces – Are the main interfaces identified and defined in a released and controlled sPHENIX Interface Control Document?
4. Management – Is the future work correctly described with an adequate number of tasks in the Resource Loaded Schedule? Is procurement, acceptance, and assembly been appropriately addressed in the schedule? Is the duration of tasks reasonable? Is it linked appropriately to other subsystems? Are there adequate resources assigned to the engineering and level 2 project team as the subsystem moves into procurement , fabrication, and assembly?
5. Quality and Acceptance – Are Q/A requirements for major components of this sub-system documented properly? Are they reasonable? Is testing and acceptance criteria been documented in the specification or statement of work and is it reasonable for the complexity, cost, and schedule impact the subsystem has to the overall sPHENIX project plan?
6. Have all recommendations from prior reviews been addressed and acceptably closed out?
7. Are there any open safety related issues that have been generated as part of the design? How will these be mitigated?

## Production Readiness Review

1. Engineering and Design – Are the drawings complete? Have they been reviewed , approved, and released by the sPHENIX Project Management Office? Are they now under configuration control? Has there been an appropriate independent review of the design? If there have been changes to the documents since the Final Design Review, have these changes been vetted properly? Are the changes still consistent with the Requirements? Has appropriate parts lists been generated for all subsystem assemblies? Have all components been identified?
2. Management - Is the schedule for procurement, including internal signatures and approvals, bid duration, material procurement, and fabrication been correctly estimated? Are they consistent with the Resource Loaded Schedule? Have all recommendations from prior reviews been properly addressed and approved by sPHENIX Project Management?
3. Fabrication – Have potential vendors been identified? Will assembly be required? Who will perform the assembly? What are the acceptance criteria for parts? Is this documented and part of the procurement package? Who will do the acceptance inspection and testing? Is shipping included in the procurement? Where will equipment be stored upon arrival at BNL?
4. Quality - What are the quality assurance requirements for this procurement? Are material certifications required? Are there intermediate inspection steps required during fabrication that will require BNL involvement? Are they clearly spelled out in the procurement documentation?
5. Safety – Have all safety requirements been satisfied and closed out?