PIP-II Technical Review Plan

Document number: TC ED0008163

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Revision History

Revision	Date Released	Description of Change
A	July 16, 2019	Major Revision
B	Nov. 1, 2019	Conventional Facilities review procedure aligned with FESS Comment and Compliance Review procedure. Expanded System Acceptance Review description for clarity. Added Accelerator Readiness Review section. Removed references to Production Readiness Review and replaced with Procurement Readiness Review. Other minor edits as necessary.
C	January 2023	Clarification of external reviewer in Section 7.5. Clarification of SDP update requirements in Section 8.3. SharePoint Review Response Template referenced and iTrack link added to review action trackers. Definition of PRR requirements and management of the review modified to remove the emphasis of the review from technical requirements and align the review to be primarily emphasizing procurement plan and strategy. Added section 9.6 for In-Kind PRRs. Added section 8.7 for review document verification process. Other minor edits as necessary. Updated Integration Review language to better align with review intent and purpose. Updated deliverable lists for PDR and FDR reviews. Added language to section 12 for tracking integration review recommendations. Updated PDR design maturity from 30-50% to 60-80% to align with project expectations. Updated Review Committee's expectations for reviewing SDP design deliverables. Added appendix with IKC Workflows. Section 7 Roles & Responsibilities updated to align with new project organization structure. Section 8.7 Review Document Verification Process updated to note location of TI team document recommendations and tracking efforts.

Table of Contents

1. Introduction

Fermi National Accelerator Laboratory (FNAL) is building a new superconducting linear accelerator and upgrading the existing synchrotron complex together designated The Proton Improvement Plan-II (PIP-II) Project. The Project is technically complex and organizationally ambitious. A first for the Office of High Energy Physics (HEP), PIP-II will incorporate into the linac significant In-Kind Contributions from international partners that will range in scope from device design and development to fully integrated superconducting linac sub-systems. Upon completion, PIP-II will deliver proton beam power exceeding 1 MW to the Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment (LBNF/DUNE). The design of PIP-II builds a technical foundation for a high-intensity proton facility ultimately capable of multi-MW beam power after future upgrades.

PIP-II requires significant design coordination and integration oversight. As part of the oversight strategy, a technical review plan specific to PIP-II is detailed in this document which does the following: establishes expectations of design and planning content and maturity at each review phase/class; gives guidance to managers to define scope and schedule of work for incorporation into the PIP-II Resource Loaded Schedule (RLS); and gives stakeholders relevant information about the status of work for their interfacing activities.

The following sections define the scope, guiding principles, review classes, stakeholder roles and responsibilities, procedure to carry out the review types, and finally review deliverables expected at each level of maturity.

2. Scope

This document defines the technical review plan the PIP-II Project will use for systems, sub-systems, and components under development at Fermilab and International Partners. This document also defines the general procedure to carryout and close a review.

3. Acronyms

A&E	Architecture and Engineering
ARR	Accelerator Readiness Review
AUP	Authorization to Use and Possession
BCR	Baseline Change Request
BOE	Basis of Estimate
CCR	Comment and Compliance Review
CF	Conventional Facilities
CoDR	Conceptual Design Review
DDD	Design Deliverables Document
DUNE	Deep Underground Neutrino Experiment
EPDM	Engineering Process Document Management
EVMS	Earned Value Management System
FDR	Final Design Review

FEM	Fermilab Engineering Manual
FESS	Facilities and Engineering Services Section
FMEA	Failure Mode and Effect Analysis
FRS	Functional Requirements Specification
FNAL	Fermi National Accelerator Laboratory
HEP	High Energy Physics
ICD	Interface Control Document
IKC	In-Kind Contributions
IPPM	Office of Integrated Planning and Performance Management
IRR	Installation Readiness Review
ISD	Interface Specification Document
L2M	WBS Level 2 Manager
L3M	WBS Level 3 Manager
LBNF	Long Baseline Neutrino Facility
MIP	Manufacturing Inspection Plan
MRR	Manufacturing Readiness Review
ORC	Operational Readiness Clearance
ORR	Operational Readiness Review
P6	Primavera Scheduling Software
PDR	Preliminary Design Review
PIP-II	Proton Improvement Plan II Project
PQR	Procedure Qualification Record
PPD	PIP-II Project Planning Document
PRD	Physics Requirements Document
PRR	Procurement Readiness Review
QA	Quality Assurance
QC	Quality Control
RA	Risk Assessment
RDS	Room Data Sheet
RLS	Resource Loaded Schedule
RSR	Requirements Specification Review
SAR	System Acceptance Review
SDP	System Design Plan

SEP	Systems Engineering Process
SPC	Partner Sub-project Coordinator
SRG	Supplemental Review Guideline
TC	Siemens Teamcenter
TIM	Technical Integration Manager
TRR	Transportation Readiness Review
TRS	Technical Requirements Specification
WBS	Work Breakdown Structure
WPQ	Weld Procedure Qualification
WPS	Weld Procedure Specification

4. Reference Documents

1	Fermilab Engineering Manual
2	PIP-II Quality Assurance Plan DocDB # 142
3	PIP-II Systems Engineering Management Plan TC ED0008164
4	PIP-II Global Requirements Document TC ED0001222
5	PIP-II Physics Requirements Documents TC ED0010216 – ED0010243
6	PIP-II Review Charge Template TC ED0008020
7	PIP-II Review Report Template TC ED0008020
8	PIP-II Review Response Template TC ED0008020
9	Indico Review Site
10	121.02 SRF and Cryo Systems Design Plan TC ED0010551
11	121.03 Accelerator Systems Design Plan TC ED0010552
12	121.04 Linac Installation and Commissioning Design Plan TC ED0010553
13	121.05 Accelerator Complex Upgrades Design Plan TC ED0010554
14	121.06 Conventional Facilities Design Plan TC ED0010555
15	FNAL Office of Integrated Planning & Performance Management Project Lessons Learned Database
16	iTrack Database
17	PIP-II Lessons-Learned log (PIP-II at Work Sharepoint)
18	PIP-II Value Engineering Plan DocDB # 2830
19	PIP-II Review Documentation Verification Tool
20	Linac Installation Supplemental Review Guidelines ED0010408
21	ES&H Supplemental Review Guidelines
22	Quality Assurance Supplemental Review Guidelines
23	Software Systems Supplemental Review Guidelines

24	Prevention through Design Assessment (ED0008508)
25	PIP-II QA/QC Planning Template DocDB # 2566
26	PIP-II Risk Register DocDB # 599
27	Fermilab ES&H Manual
28	DOE O 420.2C – Safety of Accelerator Facilities
29	FESS Standard Operating Procedure 8.3.5.1 – FESS Document Review
30	FESS Standard Operating Procedure 8.3.2.1 – FESS Construction Document Signoff
31	PIP-II Integration Review Plan DocDB # 3018
32	Policy on Records Management, Fermilab Information Management System
33	PIP-II Procurement Management Plan DocDB # 522
34	PIP-II IKC Procurement Readiness Review Template
35	PIP-II IKC Manufacturing Readiness Review Template
36	PIP-II Technical Review Document Verification Process Status Sheet

5. Guiding Principles of Reviews

The reviews and procedure detailed in this document specify how the Project will meet its technical, schedule, and budget commitments. The primary goal of technical reviews is to increase the probability of success by identifying potential or actual design and integration problems as early as possible to minimize the cost, schedule, and performance impact. Technical reviews are conducted within the framework established by the *Fermilab Engineering Manual* (FEM) [1] and are integral to the overall Quality Assurance (QA) activities defined by the *PIP-II Quality Assurance Plan* [2]. Technical reviews are a pillar of the PIP-II systems engineering activities defined in the *PIP-II Systems Engineering Management Plan* (SEMP) [3]. A comprehensive set of technical reviews are conducted within WBS L2 Systems to ensure the final achieved performance meets high-level requirements specified in the *PIP-II Global Requirements Document* (GRD), the specific systems-level requirements defined in the WBS Level 2 *Physics Requirements Documents* (PRD) and lower level functional and technical requirements as defined [4,5].

Periodic independent reviews appropriately phased to the DOE O 413.3b Critical Decision stages and Director's readiness reviews will occur throughout the life cycle of the Project but are not subject to this *PIP-II Technical Review Plan* (TRP).

6. Classes of Reviews

Reviews are classified according to design and development maturity, complexity, cost, and safety criticality. Formal review definitions are included in Section 9 of this document. All reviews defined in this document, except for Peer Reviews, are considered milestone reviews and should be identified in P6 as part of the PIP-II Earned Value Management System (EVMS). The types of project driven reviews are identified as follows:

- Peer Reviews
- Requirements and Specification Review (RSR)
- Conceptual Design Review (CoDR)
- Preliminary Design Review (PDR)
- Final Design Review (FDR)

- Procurement Readiness Review (PRR)
- Manufacturing Readiness Review (MRR)
- Design & Construction Procurement Readiness Review
- Transportation Readiness Review (TRR)
- System Acceptance Review (SAR)
- Installation Readiness Review (IRR)
- Operations Readiness Review (ORR)
- Accelerator Readiness Review (ARR)

7. Roles and Responsibilities

7.1. Technical Integration Manager

The Technical Integration Manager (TIM) has the overall responsibility to ensure the design, development, and integration processes for the PIP-II accelerator and complex follow this technical review plan. The Technical Integration Manager has the following authorities and responsibilities:

- Ensures all technical systems, sub-systems, and components are reviewed in accordance with this plan
- Approves System Design Plans (defined in Section 8.3)
- Approves each technical review closeout for compliance with this plan; is final approver in Teamcenter (TC) workflow

7.2. System Managers

The System Managers, or WBS Level 2 Managers (L2M), are the system design authorities and have overall technical and budget approval for their respective systems and sub-systems. L2M responsibilities related to technical reviews are:

- Develops and maintains a System Design Plan (SDP) that covers all elements in the L2 system
- Assures design reviews are scheduled and conducted as required for sub-systems within their respective authorities
- Appoints the Review Coordinator
- Selects the Review Committee Chair
- Approves the Review Committee Members
- Approves Review Charge
- Approves Review Responses to comments and recommendations
- Ensures that any recommendations arising from the review are adequately addressed and closed

7.3. Review Coordinator

The Review Coordinator is appointed by the L2M. The Review Coordinator organizes and plans the review and has the following responsibilities and roles:

- Forms a review committee with appropriate expertise to effectively assess each charge item and recommends a Chair

- Gives the latest PIP-II Technical Review Plan to the committee to establish the context and expectations of the review process
- Gives a review charge to the committee (written purpose and goal of the review) utilizing the *PIP-II Review Charge Template* [6]
- Gives the *PIP-II Review Report Template* to the committee Chair [7]
- Establishes an Indico website to host presentation and review materials
- Works with the technical team to create an appropriate agenda that meets the review charge
- Facilitates review logistics
- Ensures that the technical team is organized and prepared for the review by making review packages and associated materials available to the committee a minimum of one week prior to the scheduled review. Arranges pre-meetings with Review Committee as necessary to establish review goals and expected outcomes.
- Ensures linked Design Deliverable Documents (DDDs) are accessible to all reviewers and permissions are verified in advance.
- Delivers the opening statement and slides explaining the review goal and instructions to the review participants
- Assists the review Chair in leading the executive session(s) during the review
- Obtains the final report from the committee and uploads to the Teamcenter (TC) Item associated with the review

7.4. Review Committee Chair

The Review Committee Chair(s) is a topic-specific subject matter expert appointed by the Review Coordinator and approved by the L2M. The Chair serves as the primary point of contact with the review committee and has the following responsibilities:

- Coordinates questions and information requests ahead of and during the design review to address committee concerns
- Presents the committee's initial findings, comments, and recommendations during the close-out session at the end of the review
- Authors review report that answers all charge questions and includes the committee's final findings, comments, and recommendations
- Transmits the final review report to the Review Coordinator and the L2M

7.5. Review Committee

The Review Committee is selected by the Review Coordinator with the L2M approval to participate in key design or integration reviews (PDR and FDR). The committee is comprised of subject matter experts (engineering and scientific), Fermilab safety and quality representatives, and may include outside experts for critical system, sub-system and component reviews. The Review Committee has the following responsibilities:

- Consists of at least one reviewer external to the Project team (but not necessarily external to FNAL)
- Consists of reviewers external to FNAL for critical reviews as determined by the L2M or TIM
- May consist of Partner-chosen reviewers when Partner scope is impacted
- Consists of relevant subject matter experts

- Gives verbal and written feedback to the Project on whether the system, sub-system, or component and associated design deliverables documents demonstrate technical and programmatic readiness based on the review scope and class
- Provides commentary and feedback on the completeness of the included design deliverables documents or any necessary but absent documentation
- Documents their assessment
- Answers the charge questions
- Writes findings, comments, and recommendations
- Assess implementation of lessons learned in designs and planning

7.6. Level 3 Manager

The WBS Level 3 Manager (L3M) is typically responsible for the content and completion of the material under review.

- Prepares the Design Deliverable Documents (DDDs) in advance of the reviews in accordance with the SDP
- Logs all DDDs in the review charge and uploads or links as required to the review site on Indico and/or DocDB
- Serves as Review Coordinator at the L2's request
- If not assigned as Review Coordinator, assists the Review Coordinator to ensure all review materials are available on time for the review committee
- Creates a TC item associated with the technical review that will contain the charge, review report, and review response documents
- Records review responses on the Review Response form associated with the review and uploads to TC Item associated with the review [8]
- Routes the Review TC Item for approval to the L2M and the Technical Integration Manager once the Review Report and Review Responses are uploaded and complete
- Uploads copies of the released Review Report and Review Response to a PIP-II Teamcenter # associated with the review
- Ensures DDDs and review presentations are prepared and reviewed in advance of posting for the committee, including those prepared by Partners

7.7. Quality Engineer

The assigned PIP-II Quality Engineer is typically responsible for aiding the development of the PIP-II Quality Assurance and Quality Control plans. In addition to this, they ensure design review response plans are properly tracked as part of the close out of a review.

- Aids in the development of the system specific QA Plans and Subsystems QC Plans
- Uploads review recommendations to iTrack and then initiates iTrack reviews to bring recommendations to closure

8. Procedure

8.1. General Procedure to Conduct and Close a Review

This section describes the general procedure to conduct and close a technical review for the PIP-II Project. The procedure described below is written for technical reviews held at Fermilab where

the design authority resides within the Fermilab organization. The procedure defines the specific tasks by role for clarity but may be modified if necessary.

Note: Reviews conducted for Partner scope where a Partner is the authority or technical lead should follow this TRP and conduct and close reviews using a similar procedure within the constraints required of the Partner institution. The Project desires a consistent approach to all technical reviews conducted across the entire PIP-II scope of work, to the extent possible. A Partner Technical Review Workflow diagram is outlined in the Appendix.

Conducting a Technical Review

- L3M – Prepare all DDDs defined in the System Design Plan (8.3 below) for review and confirms document list in SDP agrees with documents to be presented
- L3M – Create TC Item specific to review (title and associate the item according to topic)
- L2M – select Review Coordinator
- Review Coordinator – Write Review Charge with L2M
- Review Coordinator – Form review committee and recommend a Chair
- L2M – approve committee Chair
- Review Coordinator – Prepare Indico review website (https://indico.fnal.gov/category/210/)
- Review Coordinator – organize review logistics
    - Notify participants and stakeholders of review date, location, and Indico page. Stakeholders and invitation list are included in 8.6 below.
    - Reviews requiring in-person participation of Partners, two months advanced notice is required to facilitate travel. Partner in-person participation is determined on a case-by-case basis.
    - Prepare Zoom or Teams meeting connections and send invitations
- L3M – gives review committee access to all DDDs a minimum of one week in advance of the review. For complex system reviews, a minimum of two weeks is required.
- L3M and technical teams – prepare review presentation materials and post to Indico website
- Conduct review
- Review Chair – author and submit Review Report to Review Coordinator
    - Submits final report in a timeframe agreed upon with the Review Coordinator and L2M. Typically, the review report is due a maximum of two weeks after the review is held.
    - Submission of Review Report to the Review Coordinator assumes committee approves of report content and the report is deemed final

Closing a Technical Review

A P6 schedule review milestone is achieved when a technical review is closed. A milestone may be declared achieved during Control Account Manager (CAM) schedule status meetings only after

reviewed TC item is approved by the L2M and Technical Integration Manager (or designee) and released. The goal is to close the review cycle within one week following receipt of the final committee report.

- Review Coordinator - uploads Review Report to review TC Item containing the Review Charge and Review Response documents and informs L2M and L3M
- L3M – under the guidance of the L2M, writes a Review Response with the following information:
  - List of comments and responses, if required
  - List of recommendations
  - Recommendation Responses
  - Action Items and schedule to complete by entering items in the standard Review Response Template [8]
  - Responsible party assigned to each action item
- L3M – uploads and actively manages the working Review Response Template action tracker to SharePoint.
- Quality Engineer – creates an iTrack Review/Item noting the review TC Item and a link to the action tracker, then notes the iTrack number in the Review Response document.
- L3M - Uploads the Review Response to the review TC Item containing the Review Charge and Review Report
- L3M – initiates an approval workflow process in TC to finalize the Review
  - Review Coordinator assigned as ‘Checker’
  - L2M assigned as ‘Approver’
  - Technical Integration Manager (or designee) assigned as ‘Approver’
  - Rejected workflows must be addressed and then re-sent for approval
  - Approved workflows achieve the review milestone
- L3M – Communicates the TC item and location of the action tracker to all for efficient communication of the review outcomes and planned actions. Informs CAM.
- CAM - informs PIP-II Project Controls that the review is complete, and the milestone achieved during subsequent schedule status meeting
- L3M – Implements all recommendations and closes open iTrack item.
- L2M – reviews that all recommendations have been implemented and verifies iTrack item.

8.2. Review Committee Selection

The Review Coordinator with assistance of the L2M selects review committee members and identifies a Chair who possess the relevant experience required to effectively evaluate the material presented at the technical design review or integration review. Committee members and the review Chair will be qualified to meet the responsibilities defined in Sections 7.4 and 7.5.

On occasion, to maintain schedule, a review committee may be formed without all relevant subject matter experts. In this case, review content specific to missing committee members must be

separately reviewed by relevant experts, in advance, with the review outcomes presented at the milestone review.

The committee Chair must be willing to organize and complete the Review Report at the agreed upon time.

8.3. System Design Plan

The L2M will develop a *System Design Plan* (SDP) that incorporates the relevant design review milestones into the PIP-II Project RLS for the respective L2 system. The SDP will identify Design Deliverables Documents (DDDs) associated with each review type. The SDP will be approved by the PIP-II Project Technical Integration Manager. The design reviews may be scheduled when the applicable component or system to be reviewed is ready, or, during the design stage, when significant changes have been made to the original design or concept. The SDP will list the components and systems requiring technical, safety, and any other planned reviews identified as milestones in the resource loaded schedule (RLS). The SDP will be updated as needed to maintain consistency with current project planning and for each scheduled review as noted on the active Indico review website and calendar [9]. The L2M will periodically brief the technical integration and project management teams on the status and execution of the SDP review lists and deliverables as a bi-annual update by means of a new Teamcenter Review & Approve workflow process. Table 1 lists the five *System Design Plans* and references [10-14].

WBS Level 2 System	**System Design Plan References**
121.02 SRF and Cryo Systems	TC ED0010551
121.03 Accelerator Systems	TC ED0010552
121.04 Linac Installation and Commissioning	TC ED0010553
121.05 Accelerator Complex Upgrades	TC ED0010554
121.06 Conventional Facilities	TC ED0010555

Table 1: PIP-II Project WBS L2 System Design Plans

8.4. Presentation Materials and Support Documentation

The L2M and critical stakeholders (L3Ms, design staff, Partners, etc.) prepare the presentation materials and DDDs identified in the SDP and indexed in the appropriate EPDM in TC. The Review Coordinator verifies that the planned material is properly cataloged and available for the review committee. Presentation materials and supporting documentation will be distributed in advance of the review, typically a minimum of one week before the review. Presentation materials will be posted to an Indico website within the PIP-II Project Reviews section. Copies of the relevant support documentation should be given to reviewers without TC access via the Indico or DocDB location assigned to the review and ensure that reviewers have appropriate site access to the designated document repository.

8.5. Review Report and Review Responses

The Review Chair authors the review report. Review reports are prepared using the latest *PIP-II Review Report Template*. The Review Report will include at a minimum:

- The title of the item or system under review
- A description of the item or system

- The type of review
- The date of the review
- The names and association of the reviewers
- Review attendance list
- The review agenda
- Checklist confirming design deliverables documents reviewed
- Assessment that the design meets the specified requirements and interfaces
- Assessment of the incorporation of Lessons Learned, as appropriate*
- Answers to each charge question
- Value Engineering opportunities**
- The Requests for Actions, including **Findings**, **Comments**, and **Recommendations**, where:

- **Findings** – general, factual observations about material presented, and require no response.
- **Comments** – observations with value judgments, or "soft" recommendations that require action by the design/engineering team, but where a formal written response is not required.
- **Recommendations** – items that require formal action and closure in writing prior to receiving approval to move into the next phase of the project, or items that require formal action and closure in writing prior the next review.

The review report should be completed and approved by the Chair and committee members within two weeks following the review or on a timeline negotiated with the Review Coordinator. The Chair submits the report to the Review Coordinator who then uploads the document to the TC item associated with the review.

The technical lead subject to the review, usually the L3M, writes responses to the comments and recommendations contained in the review report and logs them in the Review Response spreadsheet also uploaded to the review TC item. After the review responses are finalized, the L3M routes the overall review TC Item for L2M and Technical Integration Manager for approval.

Following the review, the L2M will ensure that all responses to comments and recommendations are technically appropriate and adequately addressed.

*The review committee should assess whether lessons-learned from similar projects have been implemented in the design and planning activities under review. Relevant lessons-learned should be part of the material presented at the review. The three sources of lessons learned are the FNAL Office of Integrated Planning and Performance Management (IPPM) lab-wide Project database, iTrack, and the PIP-II Project lessons learned log [15,16,17]. In some cases, this assessment may not be required.

**Value Engineering (VE) opportunities are often discovered during conceptual and preliminary design reviews. The Review Coordinator and/or the L2M will request of the Review Chair to collect from the review committee possible VE opportunities in accordance with the *PIP-II Value Engineering Plan* guidelines [18].

8.6. Announcement and Attendance

A review announcement and schedule will be made in advance of the review to the committee and relevant stakeholders - preferably one month prior to the date of the review. The announcement should communicate relevant details of the review, such as the system being reviewed, committee charge, the location of relevant documents, review meeting time and location, and other logistics.

In addition to the review Chair, committee, and presenters, formal invitations to the review should include the following groups:

- Technical Integration members
- Project Scientist
- L2Ms
- Interfacing L3Ms
- Partner Technical Coordinators
- Partner Project Managers
- Partner Sub-project Coordinator (SPC) (if impacted)
- PIP-II ESH Manager
- PIP-II Quality Assurance Manager

The review Chair will record attendance and include it in the final review report.

8.7. Review Document Verification Process

Documentation stakeholders have the expectation that specific deliverables are provided at each review stage per this technical review plan. A review document verification tool provides these stakeholders with a formal method of documenting and communicating feedback on the status of these deliverables to the technical integration manager. This feedback serves as input to the technical integration manager, aiding them in approving the technical review closeout.

A template for this document verification tool [19] is provided which is initiated by the technical integration team. This tool is initially populated with the document deliverables provided by the team conducting the review. It is then distributed to the appropriate documentation stakeholders for review and input. After receiving input from the stakeholders, the completed tool is shared with the technical integration manager.

This process takes place in parallel with a review and should take around two weeks to complete. If discrepancies cannot be resolved within this period, stakeholders may document these as additional recommendations within the Review Response Sheet, supplementing the recommendations provided by the review committee.

A "Review Document Verification Process Status Sheet" [36] is used to track the progress of this document review process and the associated Closeout Teamcenter document numbers for all design reviews.

9. Review Definitions and Deliverables

The review sequence and design deliverables defined in this section establish a guideline for L2Ms to plan design and development milestones. L2Ms will determine the specific design deliverables subject to review for systems within their authority and itemize the deliverables in their respective SDPs. To facilitate the identification of DDDs required for each review, Supplemental Review Guideline (SRG) documents for Linac installation and commissioning, ES&H, quality assurance, and software systems map design/compliance requirements already established at FNAL to the PIP-II design and review cycle [20, 21, 22, 23]. The general sequence of the technical review plan milestones relative to design maturity is shown below in Figure 1.

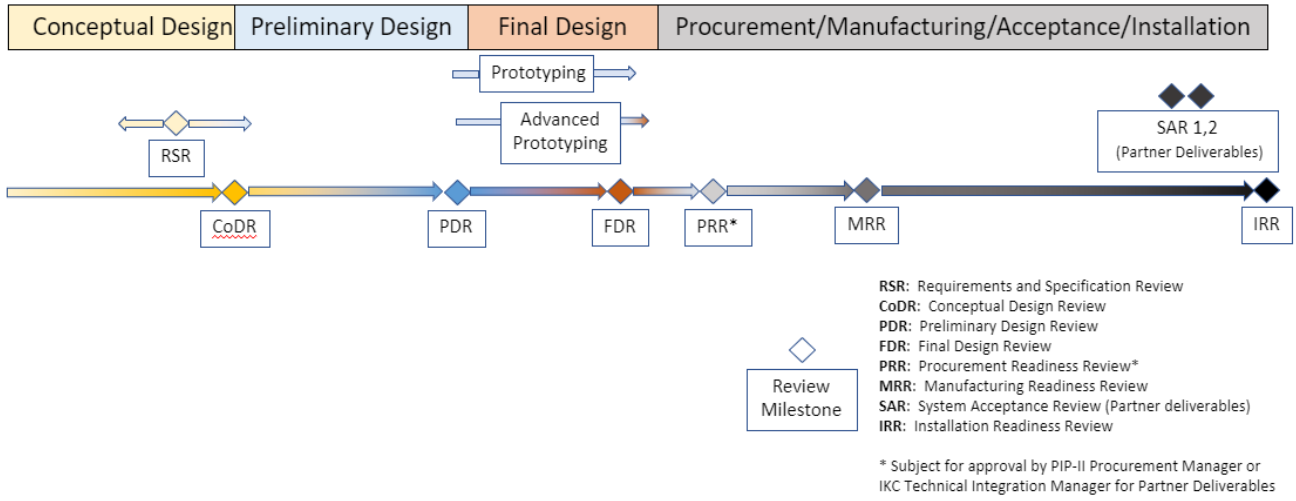

Figure 1: Technical review milestones relative to design maturity

9.1. Peer Reviews

Peer reviews are reviews typically conducted in the normal course of the design cycle at the request of a Department or Division Head or technical lead to ensure the technical team makes adequate progress toward technical milestones. Peer review milestones are not required in the resource loaded schedule (RLS) unless desired by the L2M or L3M. Outcomes of Peer reviews are often included as part of the technical basis for Project driven reviews.

9.2. Requirements and Specifications Review

A Requirements and Specification Review (RSR) is held to ensure alignment between the overall physics, functional, and technical requirements including those imparted by interfacing systems. RSRs are typically held in the conceptual or preliminary design phases at the time where requirements definitions mature sufficiently to proceed with formal design activities. The review will contain the following items and address:

- Project level requirements
- System level requirements, including physics requirements
- Functional Requirements
- Technical Requirements
- Interface Requirements
- Requirement sources
- Requirement margins

- Operations requirements
- Reliability requirements
- Traceability to functional and physics requirements
- Requirements validation and verification processes
- Specification and Requirements consistency

Documents and supporting material to be reviewed may include:

- Physics Requirement Documents
- Functional Requirements Specifications
- Technical Requirements Specifications
- Interface Control Documents

After closure of the review action items, the review outcome will be used to assist the L2M in setting the baseline system level requirements, continuation of engineering specifications and component conceptual or preliminary designs.

Formal RSRs are typically most impactful for systems or sub-systems with many interdependent requirements.

9.3. Conceptual Design Review [~5-15% Design Maturity]

The Conceptual Design Review (CoDR) is held to ensure that the objectives and requirements of the design are understood and that the proposed design approach will achieve its purposes. The emphasis will be on the requirements, how they flow down, the proposed design concept and the definition of the major system interfaces. The review will demonstrate a clear understanding of the interfaces and requirements needed for integration of the system with the rest of the Project. The review should present the major design alternatives considered, the relative risk for each, and the justification for the selection. The CoDR will contain the following items and address:

- Design Objective
- Functional Requirements Specifications (FRS)
- Preliminary Physics Requirements
- Preliminary Technical Requirements
- Preliminary Technical Interfaces
- Conceptual design that meets the requirements
- Preliminary engineering analyses to support conceptual design
- New technologies required or R&D plan and rationale
- On-going or future trade-off studies
- Alternatives Analysis
- Preliminary Prevention through Design Assessment [24]
- Engineering Risk Assessment (ERA) (Teamcenter form)
- Quality control and reliability statement
- Lessons learned from previous projects or experience
- Preliminary budget and schedule

A successful CoDR allows the design effort to proceed to the preliminary design phase.

9.4. Preliminary Design Review [~60-80% Design Maturity]

Preliminary Design Reviews (PDRs) are technical and programmatic reviews intended to assure the design approach meets the technical requirements. Detailed designs are not expected, but preliminary design and analyses are required to demonstrate compliance with requirements. Presentations of the design and interfaces by means of block diagrams, signal flow diagrams, schematics, logic diagrams, configuration and layout sketches, analyses, modeling and any early results are required. Supporting data and analyses for mechanical, power, thermal, and reliability assessments should be shown. Results from prototype testing, if available, should also be presented. In cases of significant complexity, a PDR may be required for prototype procurement (e.g. prototype SRF cavities, cryomodules, and ancillary components). Prototype PDRs enable high-cost prototyping procurements and testing to proceed. Prototype PDRs will be identified by indicating which type in the RLS activity names and in the SDPs. Preliminary system-specific QA Plans and sub-system-specific QC Plans are required for this review [25]. PDRs will contain the following items and address:

- Sub-system organizational structure and team
- Sub-system scope and deliverables
- Documented physics, functional, technical, and interface requirements
- Changes to baseline physics, functional, technical, and interface requirements
- Prevention through Design and Code Compliance
- Engineering design and analyses showing predicted performance and expected margin to relevant requirements
- Assumptions and limitations of current state of the analyses
- Draft list of critical items and single-failure point items and their analysis compared to specifications.
- Preliminary software requirements, as applicable
- Preliminary reliability and maintainability requirements
- Plan for obtaining required safety approvals
- Preliminary QA and QC plans
- Lessons learned from previous projects or experience
- Closure of requests for action from previous review
- Preliminary safety hazard assessments
- Baseline cost and schedule

Typical PDR deliverables include the following design deliverable documents (some in a preliminary stage of completion):

Requirements

- L3 Functional Requirements Specification
- L3 Technical Requirements Specification
- L4/5/6 sub-system TRS

Interfaces

- Interfaces defined in the Master Interface Control Document
- Preliminary Interface Specification Documents

Risk & Safety

- Updated Engineering Risk Assessment Document

- Updated Prevention through Design Assessment Table
- Preliminary Failure Mode Effect Analysis (FMEA), if applicable
- Updated PIP-II Project Risk Register [26]

Project Documents

- High Level Schedule Overview
- Updated Alternatives Analysis

Design

- Design review reports of all sub-systems
- Resolution of all previous relevant review recommendations
- Test reports from previous system or sub-system prototypes
- Preliminary 3D models or drawings of all major components; 50-90% complete of sub-components
- Design level schematics of major electronics systems; 50-90% schematics and layout of long duration items
- Software functional requirements and preliminary architecture
- Preliminary interlock documentation
- Preliminary System/Sub-System Engineering Calculations and Engineering Notes
- Preliminary P&ID

Procurement/Production/Installation

- Preliminary system-specific QA Plan
- Preliminary sub-system specific QC Plan
- Preliminary design and requirements verification methodology and procedures
- Preliminary system or sub-system Procurement/Manufacturing/Oversight Plan
- Preliminary sub-system assembly procedures
- Preliminary system-level assembly procedures

The completion of the PDR and the closure of any requests for action generated by the review establish the basis for proceeding with the final design phase. The L2M may request endorsement by the design review committee for long lead items procurement or for additional advanced prototypes for final design verification prior to production start.

9.5. Final Design Review [~90-100% Design Maturity]

Final Design Reviews (FDRs) are technical and programmatic reviews conducted to give assurance that the completed design achieves all physics, functional, technical, and interface requirements. The technical areas addressed during the review include the design configuration of the selected design; verification planning, requirements, and compliance; operations planning; support equipment; and systems compatibility. In cases of significant complexity, an FDR may be required for advanced prototype procurement (e.g. prototype SRF cavities, cryomodules and ancillary components). Prototype FDRs enable high-cost prototyping procurements and testing to proceed. Prototype and production FDRs will be identified by indicating which type in the RLS activity names and in the SDPs. Final Design Reviews contain the following items and address:

- Sub-system organizational structure and team
- Sub-system scope and deliverables
- The final design meets the functional, technical, and interface requirements supported by released engineering notes, drawings, schematics, software, etc.
- Prevention through Design elements addressed in the final design
- Detailed engineering analyses conducted to predict performance, including margins for relevant requirements
- A complete list of critical items, their analyses, and fabrication and test plans per applicable specifications
- Prototype verification test results that demonstrate functionality and/or technology readiness needed to start production, including performance margins relative to requirements
- Draft fabrication, assembly, test, and transportation plans (if applicable), along with lists of procedures, fixtures, and flow of work for component and sub-system fabrication, assembly, and test, and preliminary drafts of key procedures
- Draft operations and maintenance plans, including list of operating and maintenance procedures
- Quality control plans that include requirements for parts and material selection, inspection, acceptance and process control during manufacturing
- Code Compliance documents
- Updated technical, cost and schedule risk analysis, with focus on manufacturing risks
- Cost and schedule
- List of identified outstanding problem areas/open issues
- Lessons learned from previous projects or experience
- Summary of resolution of request for action from previous reviews since PDR
- Summary of PDR Review Response and resolutions

Typical FDR deliverables include:

Requirements

- L3 Functional Requirements Specification
- L3 Technical Requirements Specification
- L4/5/6 sub-system FRS/TRS

Interfaces

- Updated Interfaces defined in the Master Interface Control Document
- Interface Specification Documents
- Interface Specification Documents for Internal Sub-systems (L4 and below)

Risk & Safety

- Updated Prevention through Design Assessment Table
- Failure Mode Effect Analysis (FMEA)
- Up-to-date Risk Register

Project Documents

- High Level Schedule Overview

- Updated Alternatives Analysis

Design

- Final Design Review Reports of all Sub-Systems
- Resolution of all previous relevant review recommendations
- Test reports from Previous System/Sub-System Prototypes
- Final 3D Models/Drawings of all Major Components; 90% complete of sub-components
- Design level schematics of major electronics systems; 90% schematics and layout of long duration items
- Software functional requirements and preliminary architecture
- Final Interlock Documentation
- Approved System/Sub-System Engineering Calculations and Engineering Notes
- Final P&ID
- Engineering notes establishing design meets code standards and safety requirements (does not need to be released)

Procurement/Production/Installation

- Final system-specific QA Plan
- Final sub-system specific QC Plan
- Final Design Verification Plans and Procedures (System/All-Subsystems)
- Preliminary system or sub-system procurement and manufacturing oversight plan
- Final sub-system assembly procedures
- Final system-level assembly procedures
- Draft Installation Plan
- Draft Acceptance Plans

After the closure of action items, the L2M approves the final design where; detail drawings and assemblies can be completed, items can be purchased, and part fabrication can begin on items not requiring a formal Procurement Readiness Review.

9.6. Procurement Readiness Review

Procurement Readiness Reviews (PRRs) are milestone reviews held to initiate the procurement cycle of critical, high-value, or other procurements as defined in the *PIP-II Procurement Management Plan* [27]. This final check ensures procurement and technical teams are aligned to accomplish major procurements prior to formal solicitation. The PRR is subject for approval by the PIP-II Procurement Manager or designee.

In-Kind PRRs are a verification review of the technical documentation included in the procurement packages for certain critical or high-value procurements initiated by Partners. In-Kind PRRs are included as milestones in the PIP-II Project and Partner schedules. At the request of the Partner Sub-project Manager, the PIP-II L3M will verify the technical documentation included in the procurement packages for In-Kind milestone PRRs is correct. This verification is the responsibility of the PIP-II L3M receiving the In-Kind contribution for which the In-Kind PRR is initiated and will

ensure that the correct released versions of technical requirements, drawings, specifications, acceptance criteria, and other documents are used by Partners to procure the deliverable. The PIP-II L2M approves the results of the In-Kind PRR documentation review. The In-Kind Contributions Coordinator approves the In-Kind Procurement Readiness Review closeout for compliance with this plan. In-Kind PRRs are documented with an In-Kind PRR Form that the Partner completes and submits to the L3M for review and release through Teamcenter that catalogs the technical documentation submitted as part of the Partner procurement package [34]. The workflow to complete the In-Kind PRR is found in the Appendix. The completion, review, and release in Teamcenter of the In-Kind PRR form achieves the Partner PRR milestone.

9.7. Manufacturing Readiness Review

Manufacturing Readiness Reviews (MRRs) are held as part of the procurement cycle following vendor selection and award and prior to component fabrication or integration. MRRs are required for procurements where changes occur to designs, specifications, or requirements because of vendor input or other reasons. MRRs are not required for every procurement, but should be conducted for complex, high risk, or highly technical deliverables and included as milestones at the discretion of the L2M. MRRs are also valuable in build-to-print contracts in the event a vendor identifies design improvements for manufacturability. MRRs ensure the vendor produces what the Project requires using the latest technical information. The successful conclusion of an MRR authorizes component manufacturing to begin. An MRR will contain the following items and address:

- Final of bill of material and part list
- Final released manufacturing drawings for assembly, test, and handling fixtures
- Final production verification test plans, inspection and test travelers, and associated QA/QC documents such as travelers, component routing and handling procedures
- Final plans for manufacturing workflow, including scheduling and Project personnel involvement
- Cost and schedule updates based on manufacturing workflow plan details
- Final manufacturing control documents

Typical MRR deliverables include:

Project

- Updated production schedule
- Updated procurement cost

Design

- Final approved manufacturing drawing sets and technical specification documents
- Final design files for all electronic items
- Final assembly procedures and travelers
- Final OEM integrated component technical specification

Production

- Final Bill of Materials and parts list

- Final MIPs
- Manufacturing control documents identifying hold points
- Vendor QC Plan
- Weld Procedure Specification (WPS)
- Weld Procedure Qualification (WPQ)
- Procedure Qualification Record (PQR)
- Quotation or purchase order descriptions for procured items integrated at vendor
- Final transportation and delivery instructions

Acceptance and Verification

- Final Acceptance Criteria Document
- Final Verification Test Plan and Procedure describing all tests to verify sub-system code compliance, requirements, and interfaces

After the closure of MRR action items, the component manufacturing may begin.

In-Kind MRRs are documented with an In-Kind MRR Form that the Partner completes and submits to the L3M for review and release through Teamcenter that catalogs the technical documentation submitted as part of the Partner procurement package [35]. The workflow to complete the In-Kind MRR is found in the Appendix. The completion, review, and release in Teamcenter of the In-Kind MRR form achieves the Partner MRR milestone.

9.8. Transportation Readiness Review

Transportation Readiness Reviews (TRR) are held to ensure that sensitive equipment can be safely transported both onsite and from production facilities (Partner laboratories, industrial partners) to Fermilab for testing and installation into PIP-II. TRRs should be held for complex or delicate devices where standard packaging/crating considerations are inadequate (e.g. Cryomodule transport). The review should be held with enough time before the end of production (start of transportation) to allow final design, review, and fabrication of appropriate transportation fixtures, shipping frames, and other required equipment. In some cases, a separate design cycle with milestone reviews may be required for the tooling depending on complexity. TRRs will contain the following scope items and address:

- Demonstrate that the plan adequately protects equipment from damage
- Determine if transportation risks are well understood
- Demonstrate that the transportation plans conform to relevant laws and safety regulations
- Determine if staffing and resource allocation is adequate
- Determine if monitoring/verification plan is adequate to verify successful transport
- Lessons learned from previous projects or experience

Typical TRR Deliverables include:

Project

- Responsibility Matrix
- Updated Risk Register

Design

- Engineering analysis to assess component risk (including FMEA or equivalent)
- Transportation Requirements Specification detailing criteria required to protect all components during transport
- Shipping infrastructure design and analysis

Transportation Plan

- Analysis of chosen transportation method
- Analysis of route
- Instrumentation and data collection plan
- Instrumentation specifications
- Transportation procedure

Procurement

- Key shipping contract provisions
- Shipping contractor evaluation criteria

Acceptance and Verification

- Acceptance Criteria Documents
- Verification Test Plan
- Draft Verification Procedures

9.9. System Acceptance Review

System Acceptance Reviews (SAR) enable the transfer of ownership and technical risk associated with Partner deliverables from Partners to FNAL. SARs occur in two phases and are defined as SAR1 and SAR2 with each identified by milestone in the RLS. Each Partner, with the support of the L2M and L3M, will conduct an SAR1 to formally review and accept the deliverable at the completion of a Partner driven procurement, fabrication, or integration of a system or sub-system and prior to shipment to FNAL. At the completion of the SAR1, the Partner confirms the deliverable meets all technical specifications, requirements, and acceptance criteria, and that all documentation is complete. FNAL also confirms that the documentation is complete and authorizes the Partner to ship. FNAL conducts an SAR2 after a Partner deliverable arrives at FNAL or another Partner for integration and confirms that the deliverable meets all technical specifications, requirements, and acceptance criteria after transportation and that all documentation is received and complete as agreed upon in the PIP-II Project Planning Document (PPD). At the completion of the SAR2, the ownership of the deliverable and associated technical risk transfers to FNAL. SARs will confirm the following:

- Acceptance criteria are verified and documented
- Non-conformances are resolved and accepted
- Vendor supplied documentation is complete, including as-built documentation

- Partner produced documentation, including travelers, test reports, and bills of materials, are complete

A detailed workflow of the SAR1 Workflow and the SAR2 Workflow is shown in the Appendix.

9.10. Installation Readiness Review

Installation Readiness Reviews (IRR) serve as the final decision gate to install a major component or sub-system in the LINAC. IRRs are conducted to transfer the responsibility of a device or component from the L2M responsible supplying the device or component to the LINAC Integration L2M responsible for installing the device. IRRs are also conducted for complex systems that do not have a transfer of responsibility (e.g., cryogenics plant, cryogenics distribution system). IRRs will contain the following items and address:

- Component or sub-system level devices have met all pre-installation acceptance criteria
- Confirm installation drawings, procedures, and/or travelers the delivering party supplies are complete and released
- Confirm the necessary procedures for installation
- Confirm that all technical design and pre-installation acceptance testing documentation is completed and released, if applicable
- Identify and confirm equipment and systems conform to safety requirements
- Assure prior review recommendations are completed
- Identify and resolve remaining risk elements

Typical IRR deliverables include:

- Signed acceptance verification criteria or traveler from the originating L2M
- Installation Deliverables List – approved by L3M for Linac Installation and L3M for component owner
- Finalized procedures and installation plan
- Confirmation and closeout of all prior closed review recommendations
- Updated risk register
- List of deliverables requiring installation

9.11. Operational Readiness Review

Operational Readiness Reviews (ORR) are ES&H reviews held as part of the Operational Readiness Clearance (ORC) process. ORRs are held in accordance with *FESHM, Chapter 2005* [27].

9.12. Accelerator Readiness Review

Accelerator Readiness Reviews (ARR) are required before DOE approval for commissioning and routine operations as directed by the DOE Program Secretarial Officer or a DOE Field Element Manager as specified in DOE O 420.2C [28].

10. Contracted Design and Manufacturing Reviews

When a contract is established with a vendor to perform both the design and manufacturing activities (e.g. cryogenics plant, cryogenics distribution system), a modified review cycle is required. Since the vendor performs design activities which result in a transition directly to manufacturing, the review cycle order differs in that the vendor PDR and FDR are held following the PRR awarding the design and manufacturing contract. In these cases, the design cycle is established for the vendor during the contract execution phase. The goals of the PDR, FDR, and MRR following the contract award are the same as described above but the actual review process is specific to the vendor with guidance from FNAL. When these reviews are implemented, design deliverables lists are developed between FNAL and the vendor to align with the delivery scope. Figure 2 below shows the modified design and review cycle for contracted designs. A standard PDR and FDR review cycle with associated milestones may also be needed to complete and overall integrated system or reference design prior to a PRR and associated vendor reviews.

Build-to-print contracts often result in vendor recommended design and manufacturing drawing changes. When design changes result from vendor feedback, a final approval from FNAL is required on the manufacturing drawings prior to initiating production at the vendor.

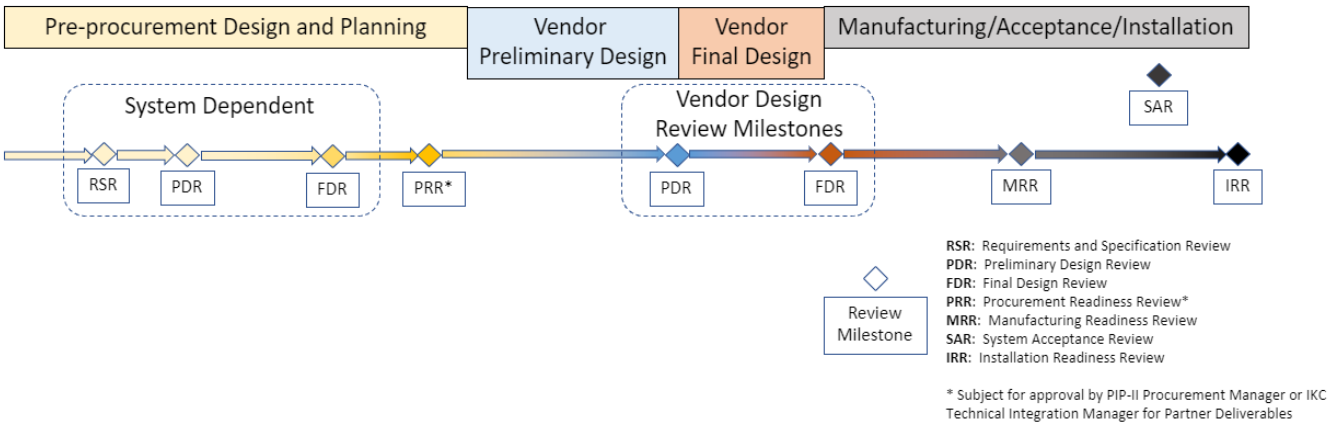

Figure 2: Design and review cycle for vendor contracted design and manufacturing

11. Conventional Facilities Reviews

The design and construction of conventional facilities elements follow a Design-Bid-Build process where an Architectural and Engineering (A&E) firm is contracted to produce the design. PIP-II Project members and Laboratory stakeholders are responsible to review and approve the design at the 60%, 90%, procurement and submittal-ready levels of maturity as defined below. All technical information associated with these reviews are collected and distributed electronically to the stakeholder reviewers.

The technical reviews for PIP-II Project Conventional Facilities (CF) scope are conducted using the FESS Comment and Compliance Review (CCR) procedure defined in the *FESS Standard Operating Procedure 8.3.5.1* [29]. The PIP-II Project requires additional verification steps to the standard CCR procedure to ensure adequate PIP-II Project-member engagement and to verify review comments and recommendations are resolved prior to closing the CCR. These steps are justified and detailed below.

- **PIP-II Project Stakeholder Participation Requirement**
  The CCR procedure includes many minor and major stakeholders as reviewers but does not explicitly require participation or confirmation that these stakeholders reviewed the technical information. The PIP-II Project requires that critical Project-member stakeholders participate in the CCRs and document their participation.

  Additional procedural steps:

  - The FESS Project Engineer (L3M) (role defined in *FESS SOP 8.3.5.1*) and the CF L2M will prepare a list of critical Project-member stakeholders to be included in the CCR participants list. The PIP-II Project Technical Integration Manager will approve the PIP-II Project stakeholder list prior to starting the CCR.

  - PIP-II Project stakeholders will document their participation in the review prior to closing a CCR. PIP-II Project stakeholders will assess whether the designs meet the Project-driven technical requirements and record their assessments by entering comments or recommendations in the comment log according to *FESS SOP 8.3.5.1*.

- **CCR Review Comment Closeout and Verification Requirement**
  Reviewers post comments and recommendations during a ten-day CCR period using the process defined in *FESS SOP 8.3.5.1* for each CCR review. At the completion of the CCR period, the CF L2M and L3M draft resolutions for each comment and recommendation. These resolutions, actions, and a schedule to complete the actions are distributed and connected by topic to the technical documents, so the A&E firm can perform the required actions noted in the Review Comment Log.

  The CF L2M will post the final version of the CCR comments, resolutions, and Review Comment Log to TC. The L2M also creates an iTrack item with a reference to the Review Comment Log, then notes the iTrack number in the CCR comments and resolutions document in TC. The L2M then routes the TC item to the Technical Integration Manager for approval. The CCR milestone is achieved once the TC item associated with the CCR review is released.

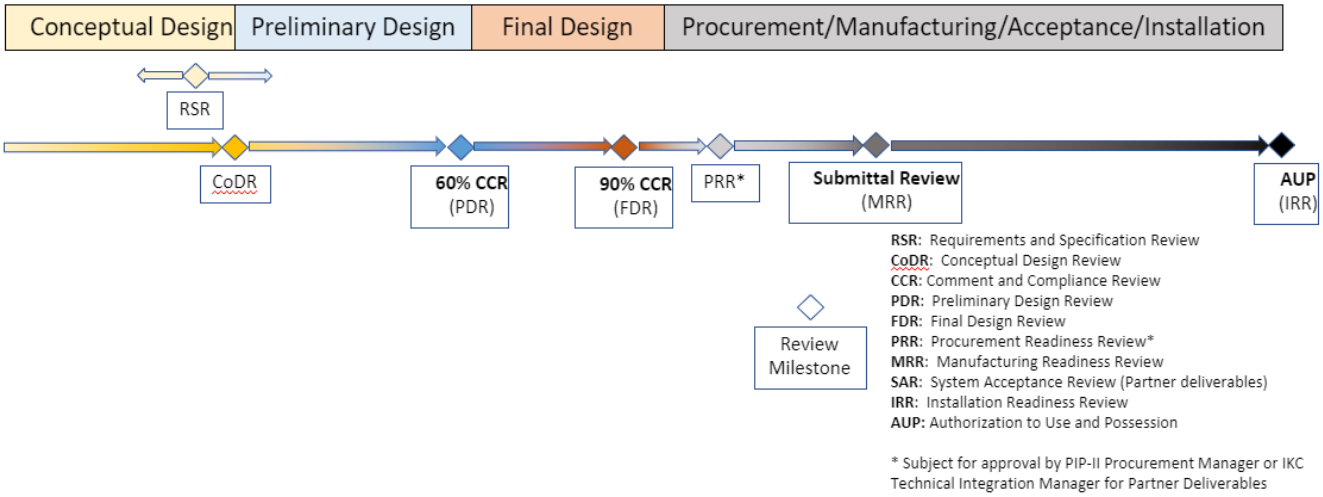

Figure 3: Design and review cycle for conventional facilities

- **Requirements and Specification Review**

  An RSR is held prior to establishing a subcontract with an architectural/engineering firm to develop detailed and final design documents. The RSR ensures alignment between the overall scientific goals and functional and technical requirements including those impacted by interfacing systems.

- **60% Comment and Compliance Review (Equivalent to Preliminary Design Review)**

  A lab-wide Comment and Compliance Review (CCR) following *FESS SOP 8.3.5.1* is held to assure the preliminary design meets the technical requirements. This CCR is issued when the design is approximately 60% completed and is equivalent to the PDR described above with respect to design maturity. This CCR is intended to review the preliminary designs for 1) appropriateness of proposed systems, 2) impacts on existing systems and operations, 3) specific technical requirements to be incorporated into the design and 4) compliance with best and required practices of authorities having jurisdiction.

- **90% Comment and Compliance Review (Equivalent to Final Design Review)**

  A second lab-wide Comment and Compliance Review (CCR) following *FESS SOP 8.3.5.1* is held to assure the final design meets the technical requirements. This CCR is issued when the design is approximately 90% completed is equivalent to the FDR described above with respect to design maturity. This CCR is intended to review the final designs for 1) appropriateness of proposed systems, 2) impacts on existing systems and operations, 3) specific technical requirements to be incorporated into the design and 4) compliance with best and required practices of authorities having jurisdiction.

- **Procurement Readiness Review**

  A PRR is held to initiate the procurement cycle and subsequent start of construction. The PRR for CF elements will include the following:

1. FESS signoff of the subcontract documents per *FESS SOP 8.3.2.1* that indicates that the documents are ready to be issued for procurement [30].
2. Review by Finance/Procurement of the subcontract documents to ensure that they are ready for competitive solicitation.

This review milestone is complete when the subcontract documents and FESS signoff are posted to TC.

- **Submittal Reviews (Equivalent to Manufacturing Readiness Reviews)**

  The bid-build procurement process requires a review of component assemblies and materials following vendor selection and award and prior to component fabrication or integration. The review of submittals will follow the procedure described in standard specification 01330 "Submittals" included in construction subcontracts. A review complete milestone (titled "All Material Submittals Complete") will be incorporated into Section 3.2, Construction Schedule, of standard specification 01001 – General Requirements included in construction subcontracts.

- **Authorization to Use and Possession (Equivalent to Installation Readiness Review)**

  An Authorization to Use and Possession (AUP) process is completed as part of the transfer of the conventional facilities to operations. This process is detailed in Section 3.4 Acceptance of standard specification 01001 – General Requirements included in construction subcontracts.

12. Integration Reviews

Integration Reviews are a class of technical reviews held to determine if systems collectively meet the performance expectations for an overall integrated system and are described in detail in the PIP-II Integration Review Plan [31]. There are two types of integration reviews: preliminary and final. A preliminary integration review is held when at least one sub-system has completed a Preliminary Design Review. Its purpose is to assess if the integrated systems are on the correct path for a final integrated design. A final integration review is held when at least one sub-system has completed Final Design Review status while others may be at an advanced preliminary design stage. Its purpose is to assess whether the individual final designs and interfaces are complete and well understood by interfacing systems and final designs meet the performance expectations for the integrated system.

Furthermore, integration reviews assess the design and interface maturity of interrelated systems and their interdependencies with each other and also cover the overall integrated system scope and how this scope is distributed among subsystems, address design and operational dependencies and assumptions, and discuss interface maturity and the impact of interface changes on other systems. System installation plans and sequencing are presented and their impacts on the overall integrated system installation.

Recommendations that come out of an integration review can span across L3 and L2 boundaries. To effectively track and address these recommendations, each recommendation shall be individually added to iTrack as separate Items. This allows for each recommendation to be tracked to closure across system boundaries.

Typical integration review deliverables include the following:

Requirements

- L3 Functional Requirements Specifications
- L3 Technical Requirements Specifications – (final integration review only)
- Physics Requirements Documents necessary to support the integration review charge

Interfaces

- Master Interface Control Document (ICD) entries
- Interface Specification Documents (ISD) – (final integration review only)

Design Documentation

- Analyses, designs, drawings, etc. necessary to support the integration review charge

Installation

- Preliminary system installation plans – (preliminary integration review)
- Final system installation plans – (final integration review)

13. Records Retention Schedule

Fermilab Information Management System policy on records management, the records associated with this process will be stored throughout the life of the related systems/subsystems, assemblies, and components [32].

Appendix – IKC Workflows

Below is a list of detailed workflows applicable to Partner Scope.

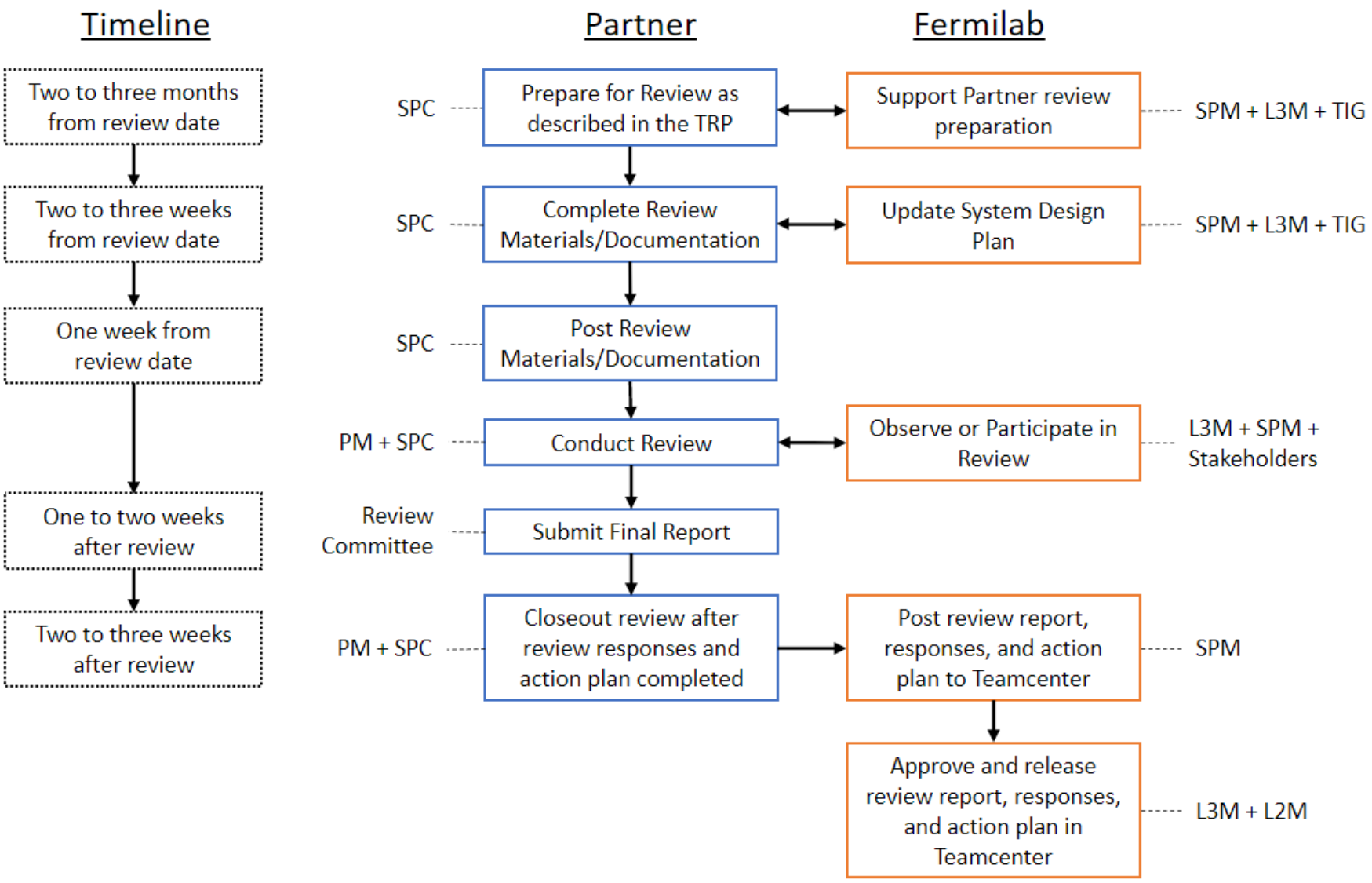

Figure A-1. Partner IKC Technical Review (PDR/FDR) Workflow.

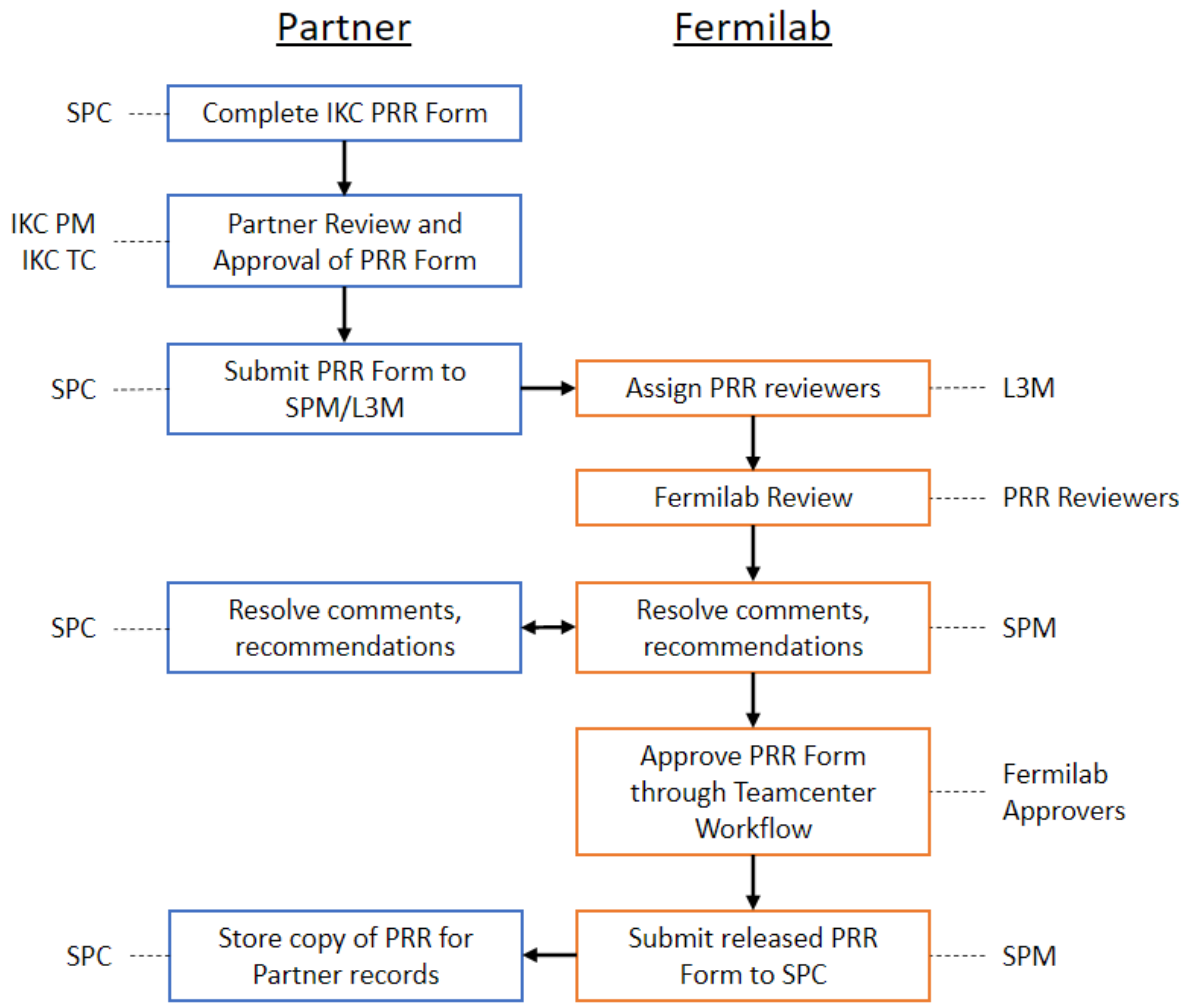

Figure A-2. Partner IKC PRR Workflow.

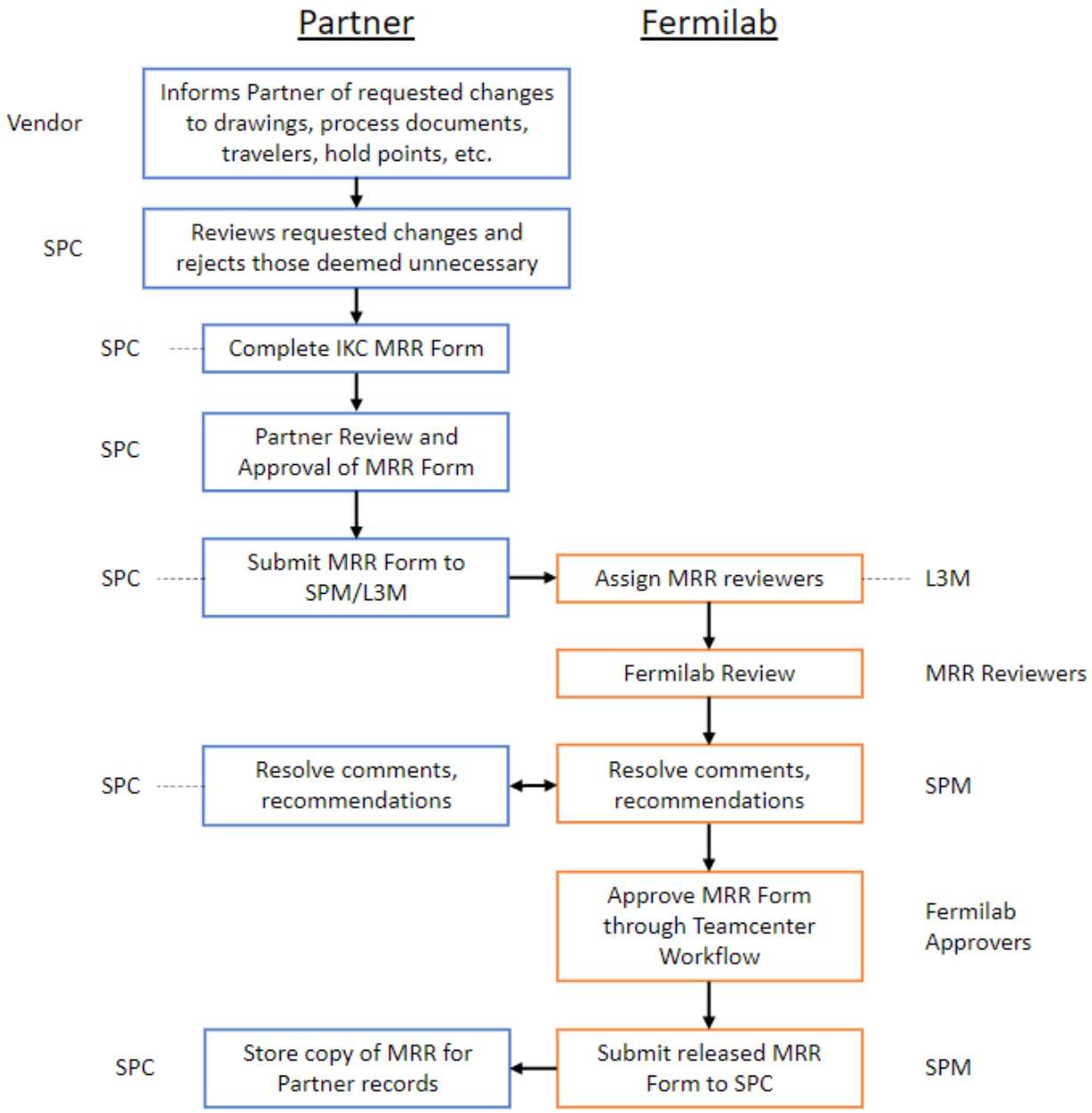

Figure A-3. Partner IKC MRR Workflow.

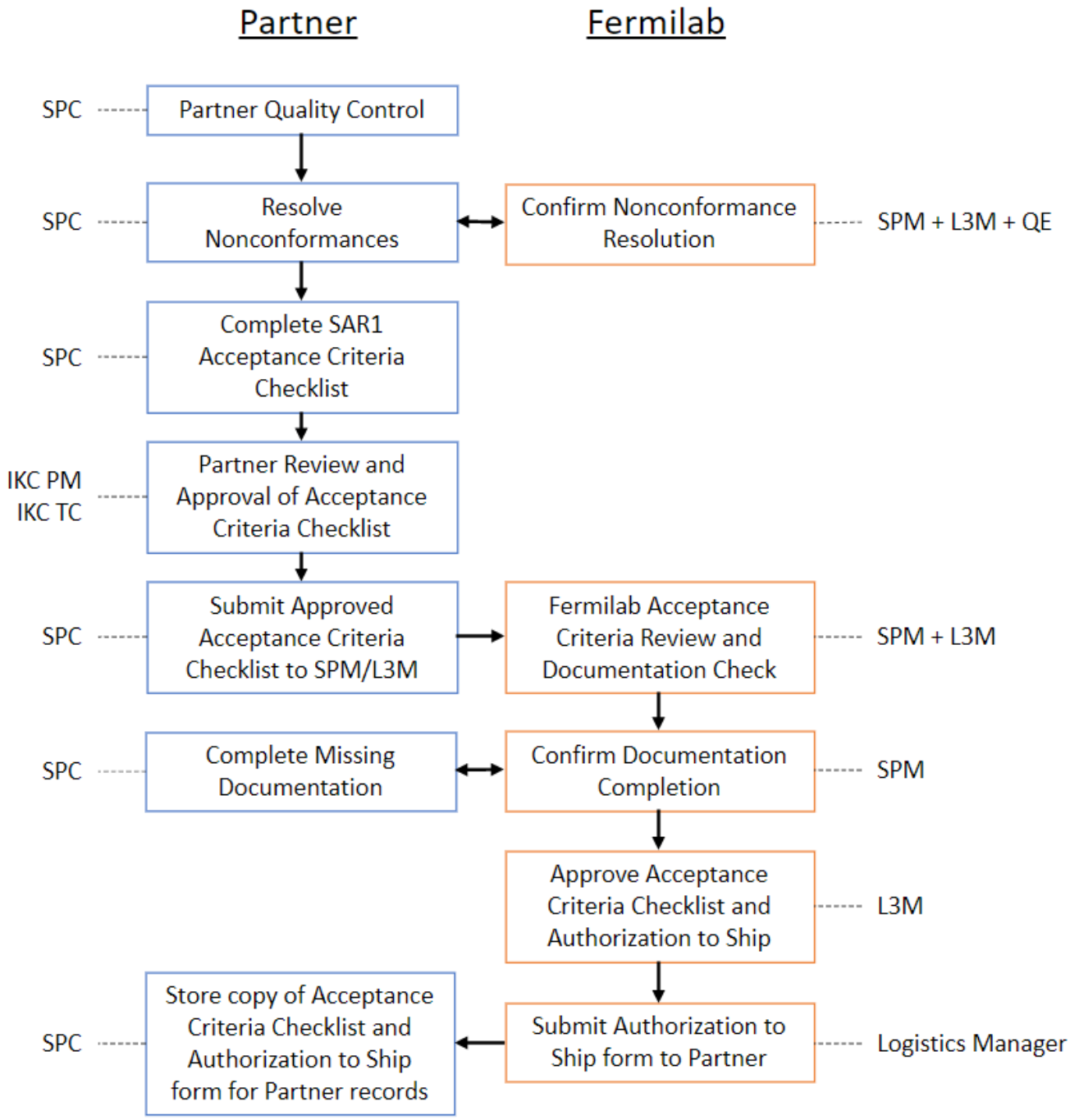

Figure A-4. SAR1 Workflow.

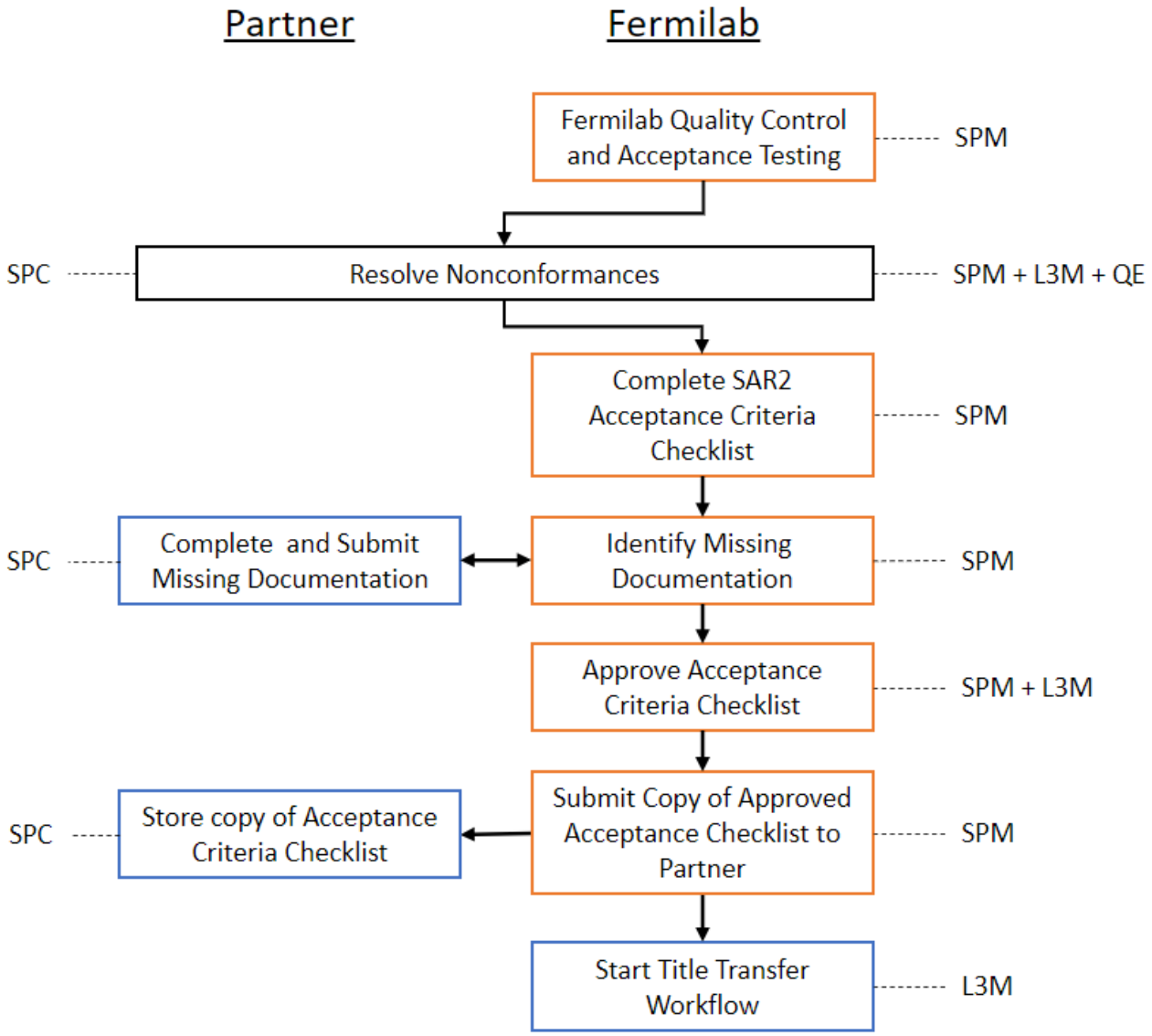

Figure A-4. SAR2 Workflow.