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| * The title of the item or system * A description of the item * WBS Number * Type of design review * Date of the review * Names of the presenters * Names, institutions and department of the reviewers * Names of all the attendees (attach sign-in sheet) * Completed Design Checklist (if utilized) | * Recommendations – these are items that require formal action and closure in writing for the review to be approved. See Document Review Guidelines PPUP-101-PC0001-R01 for Design Review Requirements and Guidelines * Comments – these are comments that require action by the design/engineering team, but a response is not required to approve the review * Findings/Observations – these are general comments and require no response |

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| Type of Review: | Preliminary Design Review (PDR) | | |
| Title of the Review: | SNS PPU Cryomodule Preliminary Design Review | | |
| WBS: | 1.02.03 Cryomodules | | |
| Presented By: | JLab Design Team (agenda includes presenters) | | |
| Report Prepared By: | Tom Nicol / Fermilab (Chair) | | |
| Reviewers / Lab : | Tom Nicol / Fermilab (Chair),  John Hogan / JLab | Date: | Review Date: 27-28 FEB 2019  Report Date: xx MMM 2019 |
| Distribution: | M. Wiseman and Design Team / JLab, M. Howell / ORNL | | |

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| Attachments: | Review Slides  Design Checklist  Calculations  Other |

| Purpose and Goal of the Review |
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| **In following the charge, the committee should respond to the following questions:**  1. Is the design of the cryomodules sufficiently mature to meet the standard for a Preliminary Design, >60% complete, and support readiness to proceed to Final Design, >90% complete, by the end of June 2019? Yes. From the start of the design effort in Sep-2018, all changes identified and conceptual design of cryomodule is complete. Readiness for FDR in June 2019 is expected.  2. Have recommendations from previous reviews been addressed? Yes. The recommendation from the Director’s review of reducing the cryomodule count from 7 to 6 was evaluated; the risk associated with achieving higher average gradient did not justify the minor cost savings. An action tracker is being maintained for the remaining recommendations showing they are in progress or have been closed.  3. Does the cryomodule design support the project KPPs? Yes. The required average cavity gradient of 16MV/m is achievable with the design and cavity processing techniques. Although not discussed directly in design-related review material, there is no reason the design would preclude achievement of the other associated project KPP goals.  4. Are the CAD model, drawings, Statements of Work (SoW’s), and Technical Specifications at a level commensurate with Preliminary Design? Yes. CAD modeling >90%; detail drawings >60%; Specifications (SOW) have reference from original production run only need minor revisions to bring up to date.  5. Have the risks been properly identified and are mitigation plans adequate? Yes. The risk registry was presented showing current status. Stated risk associated with cost, schedule & technical are appropriate based on lessons learned from previous production runs.  6. Are there unresolved issues that may have significant safety, quality, cost, schedule or performance impacts? Safety and quality, most likely not, but there are significant changes, especially in the supply and return end cans that require further development, analysis, and testing that could affect cost and schedule. |

| Introduction and Outcome Summary of the Review |
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| Recommendations |
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| The charge, agenda, presentations and supporting materials can be found at  JLab’s Indico site: <https://www.jlab.org/indico/event/312/>   |  |  | | --- | --- | | **ID** | **Committee Recommendations** | | | **1** | Keep a running list of changes incorporated in the PPU upgrade cryomodules since the SNS spare. | | **2** | Prior to FDR finalize the design decisions and fabrication plan associated with the changes from the SNS high beta spare, including the magnetic shielding, warm-to-cold beampipe assembly, end can temperature diode specification, field probe cable specification, and shipping analysis. | | **3** | Set up regular coordination meetings between SNS and JLab SRF teams to ensure mutual understanding and agreement on manufacturing processes roles and responsibilities. | | **4** | Complete procurement packages (SOW, drawings, funding profiles) for all major sub-systems. | | **5** | Verify through analysis or simulation that the dynamic response of the cold-to-warm transition joint thermal intercept flange is not detrimental to the bellows assembly during transportation. | | **6** | Perform flexibility analysis on the end can piping. | | **7** | Develop conceptual designs for cleanroom and assembly tooling. | | **8** | Verify in-tunnel clearance between cryomodules. | | **9** | Define acceptance testing criteria at Jefferson Lab (prior to shipping) and receiving acceptance criteria at SNS. | | **10** | Clarify scope for Jefferson Lab regarding shipping (preparation & design). | |  |  | |

| Comments |
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| * The project should assure itself that asking vendors to remake out-of-production components such that they are identical to legacy designs doesn’t create a longer term supply problem, for example, the harmonic drive. * The project should leave itself open to potential improvements in technology relative to the original SNS production. * To the extent possible, perform finite element analysis on simplified assembly models of the cryomodule and end cans to point out potential trouble spots, especially during transportation. * Consider a means of leak checking the bolted connection between the end cans and cryomodule prior to making the internal welded connections. * Consider the benefits of using orbital welding where practical. * Consider local shipping tests on individual components and assemblies prior to shipping the first cryomodule to SNS. * Check with Fermilab on qualification tests performed on explosion bonded Ti/SS transition joints. * Consider the necessity and the extent to which fasteners should be secured using thread locking compound, safety wire, etc. * Determine the advantage, if any, of substituting Cryoperm 10 or similar material for mu-metal on the inner magnetic shield. * Estimate whether adequate flow areas exist at the parallel plate and burst disk relief locations. * Consider CAD demonstration of cleanroom-to-spaceframe tooling interface. * Evaluate the thermal shield bellows performance under all potential operating scenarios. |

| Findings and Observations |
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