LBNF Final Design Review/Production Readiness Review Charge

Horn A Prototype

26-28 January 2021

The committee is requested to review the LBNF Horn A prototype design and determine if it meets the requirements of final design (>90% complete). More details on the LBNF/DUNE Review Plan can be found in EDMS-2173197. The LBNF Horn A is intended for operation in the initial phase of LBNF/DUNE with a 1.2 MW 120 GeV proton beam incident on a graphite target of 1.5 m – 1.8 m length that will be integrated with Horn A. This review includes the design of the Horn A conductors, stripline, interfaces and ancillary systems. The committee is also charged to determine whether the design, specifications and documentation are ready to proceed to production of long lead items for a prototype (partial Production Readiness Review). The Horn A prototype to be produced is a full horn prototype, with every component needed to actually serve as an operating horn if manufacturing, production and testing are successful. The prototype tests include pulsing on a test-stand with a prototype LBNF/DUNE target fitted to it. A summary of the documentation for this review with links to the latest versions for this review is provided at (DUNE-doc-21720). As reference, a report from the previous preliminary design review is available at (DocDB-18562).

The committee should assess the following questions for this Final Design Review:

1. Does the final design meet the requirements of LBNF/DUNE?
    a. Are the requirements clearly stated, documented and approved?
    b. Have design choices been fully identified and documented and do they meet LBNF/DUNE beamline requirements?
    c. Specifically, is the horn design lifetime sufficient to meet the beamline uptime requirement of 55% (including the annual summer shutdown) which assumes a projected efficiency for component changeout at 93%?.
    d. Does the design meet electrical design requirements?
2. Has the safety of the design been adequately assessed? Have design and analysis efforts been thoroughly addressed and validated?
    a. Have the relevant safety and engineering standards been correctly identified? Have design efforts been conducted using appropriate engineering standards and best practices (e.g., Fermilab Engineering Manual, ASME B31.3)?
    b. Has the FEA and structural analysis been completed – including the impact of both beam heat loading at 1.2 MW and thermal-mechanical loads under full current?
    c. Have appropriate safety factors been specified?
    d. Have both the FEA and structural analysis been independently reviewed? Does the independent review report demonstrate that the design complies with all applicable safety and engineering standards?

3. Have interfaces with other systems been addressed, agreed and documented?
    a. Have all interfaces with the LBNF/DUNE target been properly identified and the specifications finalized and documented?
    b. Does the design accommodate any forseen changes to the final LBNF/DUNE target design, in particular length variations within the range of 1.5 m – 1.8 m?
    c. Have all interfaces with Near Site Conventional Facilities (NSCF) been adequately identified and documented?
4. Is the plan for tests sufficient to validate the design?
5. Are all 3D CAD models available and do they demonstrate that there are no interferences with the NSCF? Are all 2D drawings complete and appropriate for final design?
6. Have the relevant lessons learned from operational experience at other neutrino beamline facilities (i.e. NuMI, BNB, T2K) been appropriately documented and incorporated in the design?
7. Have all relevant previous review recommendations been satisfactorily addressed?

The committee should assess the following questions for this Production Readiness Review for the ceramic insulators and the forgings (long lead items):

8. Are the procurement specifications or manufacturing plans appropriate?
    a. Have appropriate manufacturing and procurement methods been identified?
    b. Are the plans for procurement and fabrication oversight documented?
    c. Are all 2D drawings at a level sufficient to proceed to production?
9. Are the fabrication and assembly procedures complete and documented?
10. Have Bill of Materials been developed for the equipment being fabricated?
11. Is the final QA/QC plan sufficient and documented?
12. Is the cost and schedule reasonable?
13. Have the handling, storage and shipping procedures/plans been documented?
14. Have all resources (facilities, infrastructure, and workforce) been identified and availability of personnel assured to progress according to project schedule requirements?
15. Has the Facility Safety Program been evaluated and implemented for the scope of work to be performed?

Review Findings:

The committee should present its findings, comments and recommendations in a written report to the Review Office by 15th February 2021.