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Re: LBNF Primary Beamline LCW Preliminary Design Review

Karl Williams and Noah Curfman:

On 10/31/19 Jim Kilmer, Dave Capista and I listened to the LBNF Primary Beam LCW Preliminary Design presentation given by Karl Williams and Noah Curfman. Our panel was asked to perform a Preliminary Design Review on this system and all the relevant documentation had been uploaded in the Dune DocDB database. We were given six charge questions to address which we have done:

- 1) The preliminary design does meet the requirements of the beamline components. We feel it is mature and ready for the final design.
- 2) The design maturity presented for the LCW and bus work systems is at a level appropriate for the Preliminary Design Phase, as guided by Dune DocDB # 1069 LBNF Review Plan. In addition, we encourage the design team to start work on the final design because of the risk of attrition of key members working on the project.
- 3) All potential design, manufacturing, and installation risks and challenges have been identified within the Primary Beamline components, and it been adequately planned to address these during the final design. However, we do feel that it is very important in the final design that the model needs to be finalized, including other utilities, and we encourage the use of "stay clear" zones that would note the areas needed for the LCW. The project may want to consider laser scans after some systems are installed in order to minimize the possible number of interferences.

Additionally, it was not clear who is responsible for the design of the flags and who will integrate the design it with the final design. We recommend a cross section of each magnet,

showing if it is rolled or not, and having it show the bus and flag connections and any nearby conventional utilities.

4) The difficult design features and possible prototyping issues have been identified. The panel encourages the project to finish the model to identify interferences. We do not think a prototype is relevant, but we encourage the project to look into that.

5) The level of integration with other LBNF beamline entities is appropriate for this stage of the work. At this time, interfaces and collaborative design inputs are being managed appropriately. Moving forward, it is important to focus on integrating the model with other utilities and systems to ensure an exceptional fit in the tunnel.

6) A cursory check of the Cost and Schedule was completed, and we reviewed the known changes and design resources in the light of known complexity of certain situations. We reviewed the estimated design effort, as preliminary design effort to date has suggested that engineering and drafting resources may be under-estimated. Without knowing details of the magnet connections, it is challenging to know whether 15 man-weeks sounds weak without any information. This will not be known until the final design is finalized. The 30% contingency is low, and the project still needs to determine the bus connections. The contingency should be increased, and they should change them now.

Their Engineering Risk Assessment shows that this work is at high risk so close attention should be paid to the project, including reviews. Additionally, controls are not specified, and it is not known if the PCL and sensors are adequate for the systems. Few Fermi employees can modify the software for an LCW system and understand needs such as integrating delays. The final design needs to interface collaboration sensor layout and PLC, should be specified by mechanical engineering to control experts. The controls expectations are needed to be shown. They have covered the requirements without excessive over design.

They selected a pump size that is conservative and will be able to provide the cooling needed. Using the full power cooling requirement could have caused an increased size for the pump, they will not be using any of the magnets at full power/cooling with the present beam-line design, so the system has that extra cooling capacity built in. The bus will run at 120 watts/foot and with 48 sq-in of surface area and open to the room in the enclosure. It will not get hot and will not need added protection. The water is used to keep the temperature stable and not to cool and can be used as a manifold to circulate water.

We think the design team has done a great job with the work thus far and with their presentation.

Regards,

A handwritten signature in black ink, appearing to read "Christine Ader". The signature is written in a cursive, flowing style.

Christine Ader

Review Panel Chair

Cc: Jim Kilmer and Dave Capista