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## **CM and Cryo meeting #3**

S. Feher

6/19/2017

# Agenda

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1. US-HiLumi Director's Review Recommendations
2. AOB

S. Feher

All

# Director's Review

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## 2.0 Introduction

A Director's CD-1/3a Review of the HL-LHC Accelerator Upgrade Project (AUP) was held on June 13-15, 2017 at Fermilab. The focus of this review is the readiness of the project to proceed to the DOE CD-1/3a review scheduled for August 8-10, 2017.

The AUP Project was established to fulfill a US contribution to the accelerator portion of the HL-LHC project at CERN by delivering items that will maximize the scientific return for both CERN and US scientists. The selected alternative includes delivery of Q1 and Q3 cryo assemblies (focusing magnets) using Nb<sub>3</sub>Sn technology and dressed radio frequency dipole crab cavities. AUP is hosted at Fermilab and includes collaborators Brookhaven National Lab, Lawrence Berkeley Lab, Old Dominion University, and the Florida National High Field Magnet Lab.

## Charge Questions:

- Have performance requirements been appropriately and sufficiently defined for this stage of the project?

**Yes. Functional Requirements Specifications are signed or in advanced draft for all Magnet Elements. The draft documents should be signed by the CD-1 Review.**

- Is the conceptual design sound and likely to meet the performance requirements?

**Yes. The technical presentations described how Requirement Specifications are met by Conceptual or Technical Design.**

- Is the U.S. project scope well defined within the CERN HL-LHC project?

**Yes. The International Cooperative Agreement is signed-off between CERN and DOE (as well as addenda specifying contributions to LHC). Preliminary agreement between HL-LHC Project Leader and the Hi-Lumi Project Manager on the scope is in place. That cooperative agreement should be finalized and agreed upon by CD-2.**

- Does the conceptual design support the stated cost range and duration?

**Yes. Cost and Schedule range based on a bottom-up estimate approach is credible and technical presenters owned the estimates.**

- Is the need, technical justification and schedule justification sufficient to approve early materials procurement?

**Yes. The case presented is very convincing. This early procurement is absolutely critical for timely execution of the project.**

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## Comments

- It is of **critical** importance that the technical **project** management and system engineering in the three laboratories **runs in a smooth way** in order to be efficient in **the day-by-day decision making** on technical issues. To mitigate this risk, it is the committee's opinion that the **vacant Project Engineer position should be filled** as soon as possible and that each of the **heads of the three laboratory efforts need Deputies** during the run of the project.
- The **magnet protection** scheme consisting of **redundant outer quench-heaters and CLIQ is an adequate** baseline design. The **present plan to insert inner quench-heaters** (where extensive use **may cause insulation damage**) is **encouraged for use as a back up in the case of failure of the outer heater system**. Emergency activation of the inner heater system over a limited time period would be justified until the outer quench heater circuitry can be repaired.
- The committee encourages the **qualification of longitudinal seam welding of stainless steel cold mass shells** as planned under LARP. This qualification is a **critical engineering milestone to fully satisfy pressure code requirements** in both the US and Europe.
- An **unresolved issue** from the International Review of the Inner Triplet Quadrupoles is the **Pressure Vessel Status of the magnet cold mass**. The vessel status has to fulfill the requirements of 10CFR851 for the testing phase at FNAL and the PED requirements at CERN. Negotiation is

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ongoing about this subject with CERN and **the committee encourages resolution before the order of the kit for the Prototype Cryostat Test.**

- The committee **highly endorses the plans for each stage of the project to order more material or plan for more work at each production stage, thereby mitigating either loss-of-use or rework of the strand, cable, coils, magnets and Cryoassemblies. This practice will stop downstream activities from being starved and losing efficiency.**
- The scope of the **magnet testing** in vertical and horizontal positions **is not well defined.** The committee is of the opinion that for a series production of magnets that go into the tunnel the **testing effort shall not be more than strictly necessary** in order to reduce **risk of losing magnets.** A wise **scheme** would be to perform **training quenches in vertical test up to ultimate current,** then perform a **2-300-2K thermal cycle** and retest up to **nominal current.** During the **horizontal final acceptance test** the maximum test current can then be **nominal plus a small excess current** of some 100A.
- The committee agrees that the case for **approval of CD-3(a) for early procurement of superconductor strand and manufacture of cable is vital for the success of the Project.** After the residual LARP supplied strand is used up, **the project would have a 4 month float in supplying conductor for coil production if the CD-3(a) is approved and the order placed in April of 2018.**

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## Recommendations

15. Fill the Project Engineer function by October 2017.
16. Reach agreement on the pressure vessel safety requirements from both CERN and Fermilab and document how the requirements are implemented in the AUP prototype cryostat before procurement begins.
17. Proceed with the CD-3a procurement of Nb<sub>3</sub>Sn conductor after CD-3a approval.
18. Proceed to the CD-1 after finalizing documents and after making a project plan to meet the recent funding profile.

# Director's Review outcome

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- FRS for the Cryostat Assembly needs to be signed by August 8<sup>th</sup>, 2017
- Weld Test to be completed by the end of September, 2017
- Make significant progress on Safety Agreement between CERN and FNAL

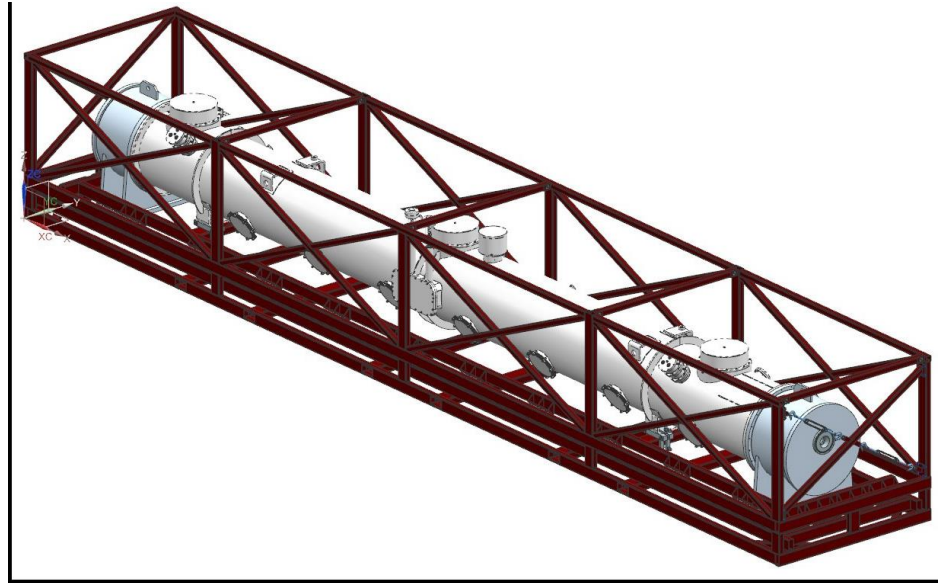
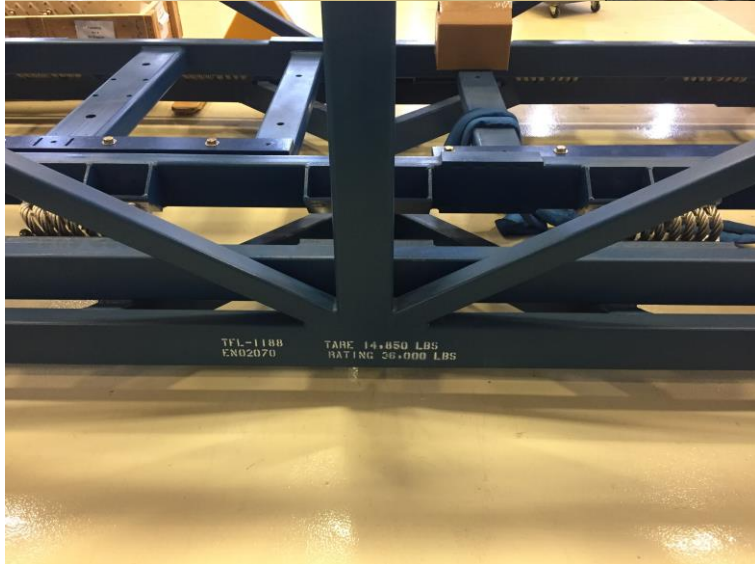


## Progress on the Lifting

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- Preliminary results from Heng pen shows that supporting the Cold Mass in the middle is necessary
- Also it is clear that 1g is not on issue at any direction for the cold mass

# Progress on the Shipping



...A system of (32) IDC M28-525-08 isolator ( $\varnothing$ 22.2 mm cable diameter) helical coils are loaded in compression and rotated at 45 degrees [7]. A design static deflection of 2.54 mm corresponds to an **80% overall shock reduction**, which remains relatively stiff and slightly under-damped...