US HL-LHC Accelerator Upgrade Project

Report of the MQXFA15 Structure & Shim Review

March 28th 2023

– Rodger Bossert, chairperson (FNAL
– Mike Anerella, (BNL)
– Susana Izquierdo Bermudez (CERN)

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1. Goal and scope

The HL-LHC AUP project is starting the assembly of MQXFA15 magnet. This is the 8th series magnet of the MQXFA low beta quadrupoles to be used in Q1 and Q3 for the High Luminosity LHC. If MQXFA15 meets MQXFA requirements [1] it will be used in a Q1/Q3 cryo-assembly to be installed in the HL-LHC.

MQXFA15 coils were reviewed on February 15, 2023 [2].

MQXFA Series magnet specifications are presented in [3]. Discrepancy or Non-Conformity Reports are generated whenever a component does not meet specifications [4].

The goal of this review is to evaluate MQXFA15 structure and shim plan. Reviewers should also assess that discrepancies and non-conformities of the magnet structure have been adequately processed, and that the shims will allow MQXFA15 to meet MQXFA requirements [1]. Technical details

Committee

– Rodger Bossert, chairperson (FNAL
– Mike Anerella, (BNL)
– Susana Izquierdo Bermudez (CERN)

Date and Time

March 28, 2023.Start time is 7:00/9:00/10:00/16:00 (LBNL/FNAL/BNL/CERN)

Location/Connection

Video-link by Zoom, info by email.

Link to agenda with talks and other documents

https://indico.fnal.gov/event/58978/

2. Review Charges responses

The committee is requested to answer the following questions:

1. Have all recommendations from previous reviews [5] been adequately addressed?

   Yes. One outstanding recommendation, to compile a list of the repairs to the PH wires, was presented.

2. Have discrepancies and non-conformities been adequately documented and processed?

   Yes.

3. If there are major non-conformities [4], have they been adequately documented and processed?

   Yes.

4. Are the proposed shims adequate for allowing MQXFA15 to meet MQXFA requirements [1]?

   Yes.

5. Do you have any other comment or recommendation to assure MQXFA15 is going to meet requirements?

   Yes.

3. Findings

1. Potting of Quench Protection heater wires on end of magnets was changed from Stycast to Green Putty to allow more robust protection.

2. Only one Fermilab coil was used on MQXFA15 and three BNL coils. Typically, two coils from each lab are used. Only two previous magnets contained different quantities of coils from each lab. These are MQXFA06 and MQXFA10, each of which had 3 FNAL coils and one BNL coil.

4. Comments

1. During the discussion of non-conformities, it was difficult to understand how far out of tolerance the non-conformities were, and also in some instances what the actual non-conformities were. A slightly more detailed discussion about the description of and magnitude of the nonconformities would have made it easier to understand.

5. Recommendations

1. Please re-introduce the electrical test after the cold pack assembly, at least for MQXFA15, where there are two coils with repaired heater to coil shorts. This test would allow you to know that you are OK after building the coil pack and prevent future more extensive disassemblies. For example, MQXFA14 had to be disassembled due to a heater to coil problem at the end of the assembly.

2. NCR #468 showed some strand damage to the lead in coil #233. (slide 28, in "Magnet Fabrication Travelers, Non-Conformities and Resolution".) Coil #233 is in the position in the cross section to be the coil that contains the long power lead, so this damage will be contained in the lead. Please consider switching this coil within the magnet with another coil, so that the damaged area to the lead will be eliminated when the internal splice is made in the splice box.
   - Note, this has already been done. Version 4 of "MQXFA Coil Pack Proposal" and version 2 of "MQXFA15 Magnet Structure and Assembly" show coils #233 and #127 switched within the cross section. The damage to the lead of coil #233 will be cut off when the internal splice is made.

6. References

1) *MQXFA Functional Requirements Specification,* US-HiLumi-doc-36.
2) *MQXFA15 Coils Acceptance Review*, US-HiLumi-doc-4797.
3) *MQXFA Series Magnet Production Specification*, US-HiLumi-doc-4009.
4) *Handling of Discrepancies and Nonconformances*, US-HiLumi-doc-2484.
5) *MQXFA14 Structure & Shims Review*, US-HiLumi-doc-4792.