US HL-LHC Accelerator Upgrade Project

Report of the MQXFA07 structure and shim review

January 21, 2021

– Peter Wanderer, BNL chairperson
– Mike Anerella, BNL
– Susana Izquierdo Bermudez, CERN
– Rodger Bossert, FNAL
– Helen Felice, observer CERN

TABLE OF CONTENTS

1. Goal and scope

The HL-LHC AUP project is starting the assembly of MQXFA07 magnet. This is the fifth and last pre-series magnet of the MQXFA low beta quadrupoles to be used in Q1 and Q3 for the High Luminosity LHC. If MQXFA07meets MQXFA requirements [1] it will be used in aQ1/Q3 cryo-assembly to be installed in the HL-LHC.MQXFA07 coils were reviewed on December 17, 2020 [2]. MQXFA pre-load targets and pre-loading sequence for MQXFA03 and following magnets were approved by AUP Technical Board on July 5, 2019 [3]. The goal of this review is to evaluate the MQXFA07 structure and shim plan. The reviewers are requested to assess that discrepancies and non-conformities of the magnet structure have been adequately processed, and that the shims will allow MQXFA07 to meet MQXFA requirements [1].

2. Technical details

Committee

– Peter Wanderer, BNL chairperson
– Mike Anerella, BNL
– Susana Izquierdo Bermudez, CERN
– Rodger Bossert, FNAL
– Helen Felice, observer CERN

Date and Time

January 21, 2021. Start time is 7/9/10/15 (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/47119/

3. Review Charges response

The committee was requested to answer the following questions:

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

2. If there are major non-conformities, have they been adequately documented and processed? Yes.

3. Are the proposed shims adequate for allowing MQXFA07 to meet MQXFA requirements [1]? Yes.
   Finding: The process for determining the shims was the same as for recent magnets.

4. Is there anything that could prevent MQXFA07 to meet the MQXFA Interface Specification [4]? No.

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

6. Do you have any other comment or recommendation to assure MQXFA07is going to meet requirements? See comments below.

4. Comments

These comments are made to have a more robust and standard process in preparation for the many magnets that need to be assembled.

1. Presently a preload requirement is a maximum of 110 MPa based on strain gauge measurements at assembly. This requirement would be better understood if it included variations of coil size along the length. To do so would require an additional coil size measurement precisely at the strain gauge location, and then a comparison of the maximum coil size measurement as compared to the measurement at the strain gauge location, using the known increase in coil preload as a function of azimuthal coil size.

2. The coil preload target is 80 MPa +/- 8 MPa. Below the minimum target “at some threshold” a low coil preload is reported to the L2 Manager. It would be an improvement if this value and reporting mechanism are formalized and include the effect of reduction in coil preload away from the measurement, based on a)

minimum coil size away from the strain gauge location known from coil measurements as well as b) coil preload reduction at shell edges.

5. Recommendations

Proceed with the assembly.

6. References

1)MQXFA Functional Requirements Specification, US-HiLumi-doc-36.
2)MQXFA07Coils Acceptance Review, US-HiLumi-doc-3984.
3)MQXFA03 pre-load targets and pre-loading sequence, US-HiLumi-doc-2496.
4)MQXFA Magnet Interface Specification, US-HiLumi-doc-1674.
5)MQXFA06 Structure & Shims Review, US-HiLumi-doc-3719.