Documentation status for MQXF

Paolo Ferracin

on behalf of the MQXF collaboration

WP3 Meeting
05 July 2017
CERN

Acknowledgments

- CERN
  - A. Ballarino, H. Bajas, M. Bajko, B. Bordini, J.C. Perez, S. Izquierdo Bermudez, J. Ferradas Troitino, P. Fessia, C. Fichera, L. Fiscarelli, P. Grosclaude, M. Guinchard, P. Hagen, O. Housiaux, F. Lackner, P. Moyret, H. Prin, E. Rochepault, S. Sequeira Tavares, E. Todesco, G. Vallone
- BNL
  - M. Anerella, A. Ghosh, P. Joshi, J. Muratore, J. Schmalzle, P. Wanderer
- FNAL
  - G. Ambrosio, R. Bossert, G. Chlachidze, L. Cooley, E. Holik, S. Krave, F. Nobrega, I. Novitsky, C. Santini, S. Stoynev, T. Strauss, M. Yu
- LBNL
  - D. Cheng, D.R. Dietderich, R. Hafalia, M. Marchevsky, H. Pan, I. Pong, S. Prestemon, E. Ravaioli, G. Sabbi, X. Wang
- SLAC
  - Y. Nosochkov
- CEA Saclay
  - H. Felice
- LASA
  - V. Marinozzi, M. Sorbi
- Tampere Univerisity of Technology
  - T. Salmi

Outline

- Is there an engineering design report ?
- Do we have manufacturing drawing ? Where are stored ? Is this in the CERN system?
- Do we have assembly procedures written ? Are they store in CERN system?
- For magnets done until now:
  - Do we have an official name for the magnet
  - Is there a MTF folder
  - Do we have components associated to the magnet (traceability)
  - Are cable data stored or linked to the magnet page
  - Do we have coil dimensional measurements?
  - Do we have the pre-stress measurements stored somewhere and or linked to the magnet page in MTF?
- Do we have quench performance stored somewhere and or linked to magnet page
- Same for magnetic measurements
- When are we planning to have the first magnet/model/prototype with the standard MTF filled?

Is there an engineering design report ?

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US HL-LHC AUP

US HL-LHC Accelerator Upgrade Project

Q1/Q3 Cryo-Assemblies Conceptual Design Report

Prepared by:
Giorgio Ambrosio, US HL-LHC AUP L2 Manager, FNAL
Daniel Chang, US HL-LHC AUP 302.2.07 Deputy Manager, LBNL
Guram Chlachidze US HL-LHC AUP 302.2.11 Manager, FNAL
Lance Cooley, US HL-LHC AUP 302.2.02 Manager, FNAL
Delio Duarte Ramos, HL-LHC WP3 Engineer, CERN
Sandor Feher, US HL-LHC AUP 302.2.09 and 302.2.10 Manager, FNAL
Paolo Ferracin, HL-LHC WP3 Scientist, CERN
Susana Izquierdo Bermudez, HL-LHC WP3 Scientist, CERN
Joseph Muratore, US HL-LHC AUP 302.2.08 Manager, BNL
Fred Nobrega, US HL-LHC AUP 302.2.05 Manager, FNAL
Heng Pan, US HL-LHC AUP 302.2.07 Engineer, LBNL
Ian Pong, US HL-LHC AUP 302.2.03 Manager, LBNL
Herve' Prin, HL-LHC WP3 Engineer, CERN
Emmanuele Ravaioli, US HL-LHC AUP 302.2.01 Scientist, LBNL
GianLuca Sabbi, US HL-LHC AUP 302.2.01 Scientist, LBNL
Jesse Schmalzle, US HL-LHC AUP 302.2.06 Manager, BNL
Ezio Todesco, HL-LHC WP3 Manager, CERN
Miao Yu, US HL-LHC AUP 302.2.04 Manager, FNAL

Reviewed by:
Giorgio Ambrosio, US HL-LHC AUP L2 Manager, FNAL
Ruben Carcagno, US HL-LHC AUP Deputy Project Manager, FNAL

Approved by:
Giorgio Apollinari, US HL-LHC AUP Project Manager, FNAL

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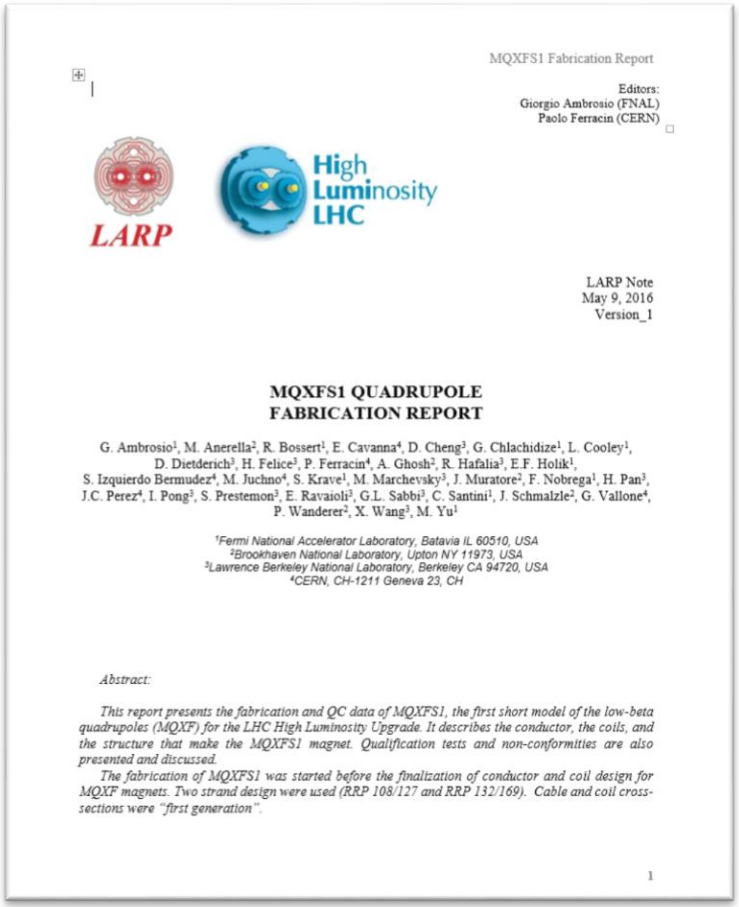

MQXFS1 Fabrication Report

Editors:
Giorgio Ambrosio (FNAL)
Paolo Ferracin (CERN)

LARP

High Luminosity LHC

LARP Note
May 9, 2016
Version_1

MQXFS1 QUADRUPOLE FABRICATION REPORT

G. Ambrosio[1], M. Anerella[2], R. Bossert[1], E. Cavanna[4], D. Cheng[3], G. Chlachidze[1], L. Cooley[1], D. Dietderich[3], H. Felice[3], P. Ferracin[4], A. Ghosh[2], R. Hafalia[3], E.F. Holik[1], S. Izquierdo Bermudez[4], M. Juchno[4], S. Krave[1], M. Marchevsky[3], J. Muratore[2], F. Nobrega[1], H. Pan[3], J.C. Perez[4], I. Pong[3], S. Prestemon[3], E. Ravaioli[3], G.L. Sabbi[3], C. Santini[1], J. Schmalzle[2], G. Vallone[4], P. Wanderer[2], X. Wang[3], M. Yu[1]

[1]*Fermi National Accelerator Laboratory, Batavia IL 60510, USA*
[2]*Brookhaven National Laboratory, Upton NY 11973, USA*
[3]*Lawrence Berkeley National Laboratory, Berkeley CA 94720, USA*
[4]*CERN, CH-1211 Geneva 23, CH*

Abstract:

This report presents the fabrication and QC data of MQXFS1, the first short model of the low-beta quadrupoles (MQXF) for the LHC High Luminosity Upgrade. It describes the conductor, the coils, and the structure that make the MQXFS1 magnet. Qualification tests and non-conformities are also presented and discussed.

The fabrication of MQXFS1 was started before the finalization of conductor and coil design for MQXF magnets. Two strand design were used (RRP 108/127 and RRP 132/169). Cable and coil cross-sections were "first generation".

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HiLumi HL-LHC PROJECT LARP US HL-LHC AUP

Do we have manufacturing drawings ? Where are stored ? Is this in the CERN system?

- Yes, everything is stored in CDD
  - LHCMQXFT0000: tooling for coil fab. and assembly, model and prototype
  - LHCMQXFM0000: coil parts model
  - LHCMQXFM0000: support structure model
  - LHCMQXFM0000: coil parts prototype
  - LHCMQXFB0000: support structure prototype
- Equipment codes set by Herve' and others
  - LHCLQXF: cryo-assembly
  - LHCLMQXF: cold-mass
  - LHCMQXFB: magnet
  - LHCMQXFBC: coil
- It was not possible to use LHCMQXFBC since it had too many characters
- Now it is possible, but all drawings already used for MS, IT, procurement of coil parts
- We have to converge on the equipment code for the prototype

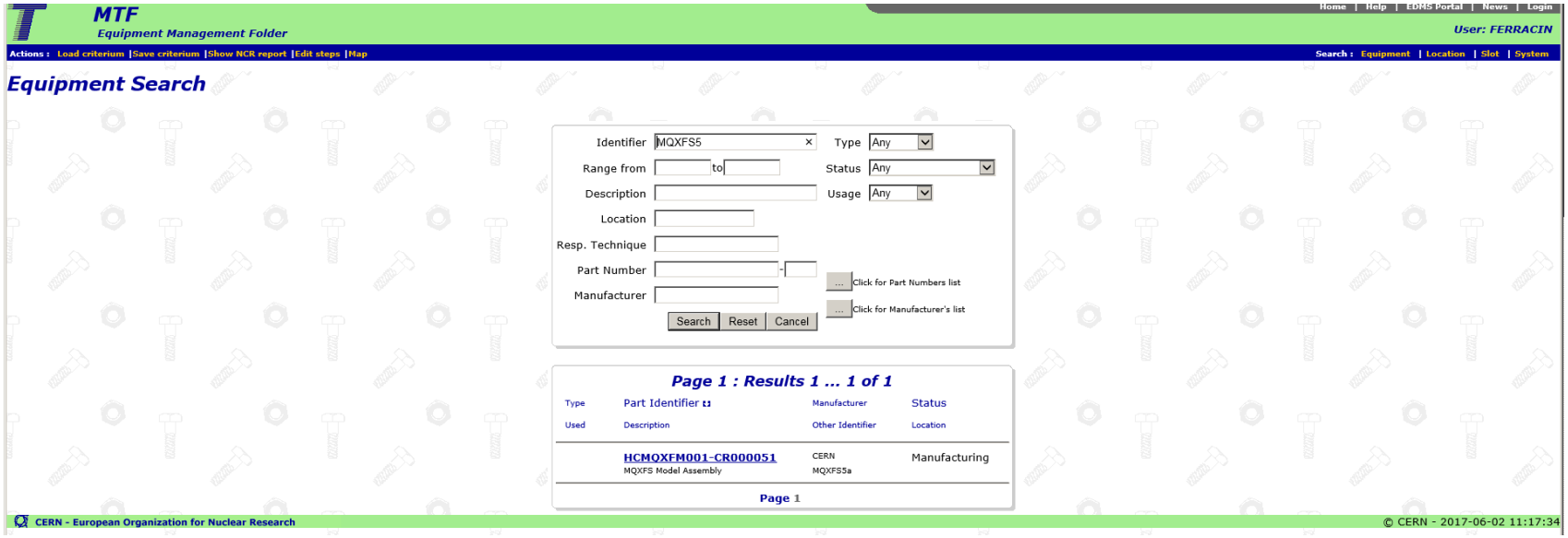
Do we have assembly procedures written ? Are they store in CERN system?

- Short model
  - To be uploaded in EDMS soon
    - Winding, curing, splicing, instrumentation
  - Work in progress
    - Reaction, impregnation and assembly
- MQXFB
  - Procedure available in edms (*Q2 [MQXFBC] Manufacturing procedures, CERN-0000171175*)
    - Winding, curing, reaction, impregnation, splicing

Document Id	Version	Document Project Id	Title
1736688	0.1	LHC-MQXFBC-FP-0021	LHC-MQXFBC-FP-0021-Flowchart-de-fabrication-d'une-bobine-non-réagie
1726011	0.2	LHC-MQXFBC-FP-0013	LHC-MQXFBC-FP-0013-MIP-fabrication-bobine
1726014	0.1	LHC-MQXFBC-FP-0014	LHC-MQXFBC-FP-0014-fiche-de-suivi-fabrication-bobine
1726000	0.1	LHC-MQXFBC-FP-0012	LHC-MQXFBC-FP-0012-Mise en cassette
1689312	0.5	LHC-MQXFBC-FP-0001	LHC-MQXFBC-FP-0001-Bobinage Prototype MQXF Nb3Sn
1725988	0.1	LHC-MQXFBC-FP-0011	LHC-MQXFBC-FP-0011-Polymérisation couche interne ou externe
1726069	0.3	LHC-MQXFBC-FP-0018	LHC-MQXFBC-FP-0018-fabrication-interlayer
1747779	0.1	LHC-MQXFBC-FP-0024	LHC-MQXFBC-FP-0024-MIP-reaction-impregnation-bobine
1726017	0.1	LHC-MQXFBC-FP-0015	LHC-MQXFBC-FP-0006-réaction-bobine
1726020	0.1	LHC-MQXFBC-FP-0016	LHC-MQXFBC-FP-0007-splicing
1726065	0.1	LHC-MQXFBC-FP-0017	LHC-MQXFBC-FP-0008-impregnation
1765859	0.3	LHC-MBH_C-FP-0025	TE-MSC-LMF-QA-CWC-11T-impregnation-protocole
1807234	0.3	LHC-MBH_C-FP-0040	TE-MSC-LMF-QA-CWC-11T-impregnation-and-cleaning-sub-process
1726999	0.1	LHC-MQXFBC-FP-0019	LHC-MQXFBC-FP-0010-Manutention-bobine
1816175	0.1	LHC-MQXFBC-FP-0035	LHC-MQXFBC-FP-0035-fiche-de-suivi-fabrication-splicing

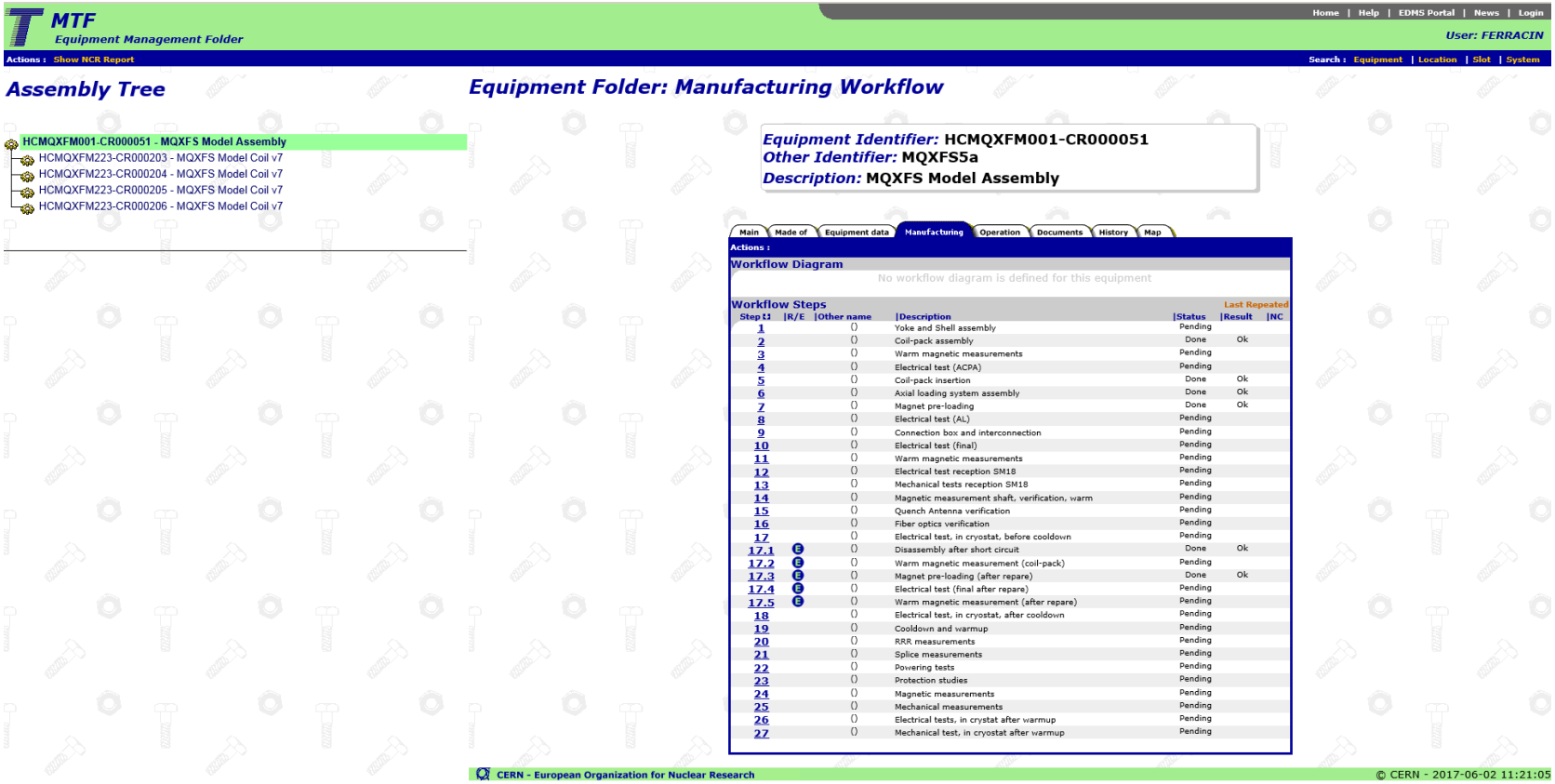
Do we have an official name for the magnet? Is there a MTF folder?

- MQXFS5 first model in MTF
- Official name: HCMQXFM001-CR000051
  - “5” for the model, “1” for “a”, “2” for “b” and so on



Do we have an official name for the magnet? Is there a MTF folder?

- Manufacturing steps defined
- Data to be included (work in progress by N. Bourcey)
- Next model MQXFS3c→ "…..33"



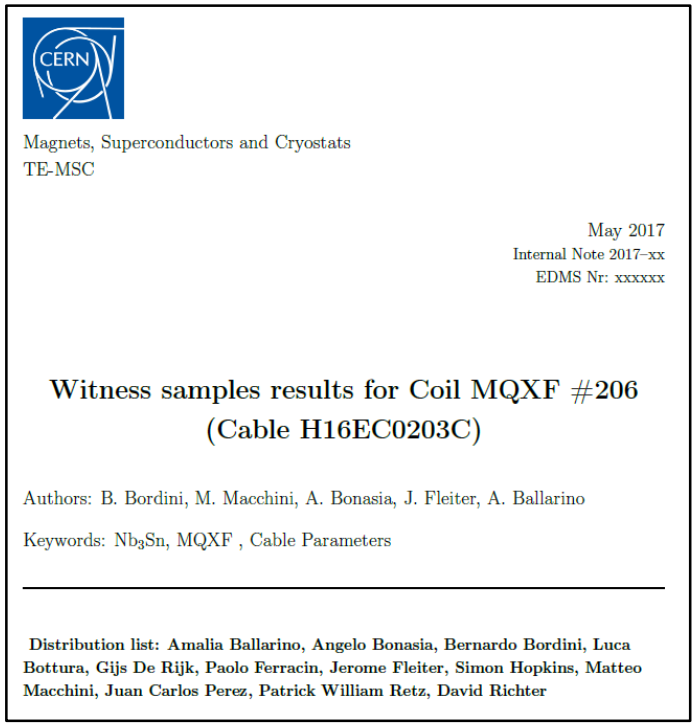
Do we have an official name for the magnet? Is there a MTF folder?

- Status in 180
  - Everything is ready to start the set-up in MTF, but we need to decide about equipment code,
  - Work in Progress by Olivier Housiaux and Sabine Menu
- Status for AUP magnets
  - In the US HL-AUP QA Plan (currently draft), we state we will generate MIPs and upload them to the CERN EDMS.
  - We also state that we will use MTF to upload data deliverables.
  - We are working towards testing the use of these systems for the pre-production coils.

Do we have components associated to the magnet (traceability)?

- Not done for short models
- MQXFB: this is the plan, work in progress.

Are cable data stored or linked to the magnet page



Magnets, Superconductors and Cryostats
TE-MSC

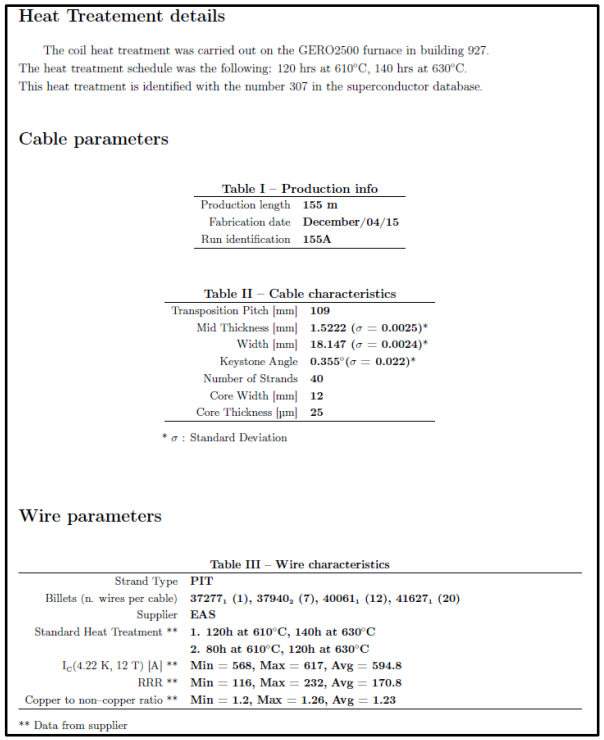
May 2017
Internal Note 2017–xx
EDMS Nr: xxxxxx

Witness samples results for Coil MQXF #206 (Cable H16EC0203C)

Authors: B. Bordini, M. Macchini, A. Bonasia, J. Fleiter, A. Ballarino

Keywords: Nb_3Sn, MQXF , Cable Parameters

Distribution list: Amalia Ballarino, Angelo Bonasia, Bernardo Bordini, Luca Bottura, Gijs De Rijk, Paolo Ferracin, Jerome Fleiter, Simon Hopkins, Matteo Macchini, Juan Carlos Perez, Patrick William Retz, David Richter



Heat Treatement details

The coil heat treatment was carried out on the GERO2500 furnace in building 927. The heat treatment schedule was the following: 120 hrs at 610°C, 140 hrs at 630°C. This heat treatment is identified with the number 307 in the superconductor database.

Cable parameters

Table I – Production info

Production length	**155 m**
Fabrication date	**December/04/15**
Run identification	**155A**

Table II – Cable characteristics

Transposition Pitch [mm]	**109**
Mid Thickness [mm]	**1.5222 (σ = 0.0025)***
Width [mm]	**18.147 (σ = 0.0024)***
Keystone Angle	**0.355°(σ = 0.022)***
Number of Strands	**40**
Core Width [mm]	**12**
Core Thickness [µm]	**25**

* σ : Standard Deviation

Wire parameters

Table III – Wire characteristics

Strand Type	**PIT**
Billets (n. wires per cable)	**37277_1 (1), 37940_2 (7), 40061_1 (12), 41627_1 (20)**
Supplier	**EAS**
Standard Heat Treatment **	**1. 120h at 610°C, 140h at 630°C**
	2. 80h at 610°C, 120h at 630°C
I_C(4.22 K, 12 T) [A] **	**Min = 568, Max = 617, Avg = 594.8**
RRR **	**Min = 116, Max = 232, Avg = 170.8**
Copper to non–copper ratio **	**Min = 1.2, Max = 1.26, Avg = 1.23**

** Data from supplier

- In EMDS note with
  - Cable/wire parameters
  - Cable qualification samples and witness sample
- To be added to MTF page, but we need equipment code
  - It will be done in the same way as the 11T

Coils and magnets electrical tests

- MQXFS (MDT)
  - Status
    - Data for each coil stored in
      - *G:\Workspaces\m\MDT\Magnet_Laboratory\Projects*
      - *\HFM_Program\HiLumi_Magnets\MQXF\MQXFS*
      - *\Reference_information\Technical_Data*
      - *\Electrical documents\Electrical test results*
    - Data for each magnet stored in
      - *G:\Workspaces\m\MDT\Magnet_Laboratory\Projects\HFM_Program*
      - *\HiLumi_Magnets\MQXF\MQXFS\Magnets_Construction*
      - *\MQXFS_magnets\MQXFS5a\11_Electrical_documentation*
  - Plan
    - Upload files in MTF
- MQXFB (LMF)
  - Status, to be uploaded in MTF

Coils and coil parts' dimensional measurements

- MQXFS (MDT)
  - Status
    - Data for each coil and magnet fabricated stored in
      - *G:\Workspaces\s\ShortModLab927Metrology*
  - Plan
    - Produce a pdf file report for coils and magnets and upload in MTF
- MQXFB (LMF)
  - Status
    - Data in edms (https://edms.cern.ch/document/1825459/1)
  - Plan
    - Produce a pdf file report for coils and magnets and upload in MTF

Do we have the pre-stress measurements stored and or linked to the MTF magnet page?

- Yes, for MQXFS5 it was done.
  - Next MQXFS3c

Do we have quench performance stored somewhere and or linked to magnet page

- All data in SM18 folder
  - **Strain gauges data**
    - \\cs-ccr-nfsdev\mtbop\MTB_strain_
  - **Fiber Optic data**
    - \\cs-ccr-nfsdev\mtbop\MTB_fos\
  - **Voltage/current data**
    - \\cs-ccr-nfsdev\mtbop\MTB_meas\
    - Raw data:
      - \\cs-ccr-nfsdev\mtbop\MTB_meas\DAQ\
    - Converted data:
      - \\cs-ccr-nfsdev\mtbop\MTB_meas\DAQ_TDMS\
    - Analysed data:
      - \\cs-ccr-nfsdev\mtbop\MTB_meas\ANALYSIS\
- **Report, test doc, presentation, etc…**
  - G:\Workspaces\m\matest\Test results and reports\2.VERTICAL\MAGNET_TESTS\Nb3Sn magnets
- Plan: upload in MTF for MQXFS5

Do we have magnetic measurements stored somewhere and or linked to magnet page

- All the data and analysis stored in
  - \\CERN\dfs\Workspaces\m\MM_MQXF
    - With 2 folders
      - “measurements” and “analysis”.
- Plan: upload data in MTF

When first magnet/model/prototype with the standard MTF filled?

- Third model: MQXFS5
- First prototype: LQXFC/D-P1