Minutes of meeting D2 Short model Cryogenic test interface meeting #01 – 07 June 2017

Presents: CERN: Arnaud Foussat (AFT) Hugo Bajas (HBS), Antonella Chiuchiolo (ACO), Michael Guinchard (MGD), Nicolas Peray (NPY), Lucio Fiscarelli (LFI),
INFN : Pasquale Fabbricatore (PFE), Stefania Farinon (SFN),

Excused: Marta Bajko, Ezio Todesco, Roberto Cereseto, Andrea Bersani

Agenda items: Indico link 645011

1. Introduction (CERN, AFT)
2. Presentation of D2 short model (layout, dimensions, interfaces, cables, structure design) (INFN, PFE)
3. Presentation of vertical test cryostat, main interfaces, common mechanical adaptation, (CERN TF, HBS)
4. Instrumentation table by INFN, discussions (all)
5. Discussion on DAQ instrumentation interface : connectors types (QHs, VTs, SG, TS) , leads lengths, number of channels (CERN TF, EN-MME M Guinchard)
6. Optical strain fiber experience on MQX, discussion coil OF sensing proposal (A. Chiuchiolo)
7. Discussion on interface preparation of coils, cryostat (structure preload, splices on leads, Cryostat interface flange) (INFN, CERN)
8. QA Hi-Voltage test before transport (INFN) , at reception and after CD test (CERN)
9. Overall updated SM coil Schedule (INFN)
10. AOB

Outcome of meeting :

AFT presented the objectives of this meeting and the actions in next three months to finalise the test interfaces on D2 short model;

Cryostat interface:

HBS presented the common cluster D test cryostat which is the suggested for the D2 SM test during the period of May 2018. The lambda plate is equipped with standard cold connectors and instrumentation wires on D2 magnet shall be equipped with matching connectors
The top plate of the insert if equipped with three holes for the passage of the magnetic shaft which can accommodate slight angle.
An integration drawings shall be prepared by N Peray TE MSC to show the magnet installation with the magnetic measurement shaft assembly and all power and instrumentation connections.
HBS has shown two ways of mechanical suspension from the top lambda plate which can be adapted either on the D2.

AI-1: NPY (CERN) to issue a drawing of integration of D2 short model – end Jan 2018
AI-2: CERN to propose to INFN the design of mechanical supporting of D2 short model within test insert. HBS shall send the technical layout drawings of possible solutions -- Dec 2017
AI-3: HBS shall send the technical layout drawings of possible solutions – Aug 2017

- The extension leads length shall be communicated for connection to current leads

AI-4: INFN to design connector layout on support plate and to allocate standard connectors to the instrumentation wires – Nov. 2017

Magnetic measurement

LFI presented the shaft measurement equipment used on large bore size. An outer protection fiber glass tube of 103 mm is used. This leaves only 1 mm clearance on outer radius once installed and put stringent The active length of the existing shaft is 2.2m based on 5 segments. The central segment shall be aligned with the magnetic center of D2 so to measure the field quality profile in straight region and in the heads, as well as the integral field.

The shaft has measuring radius of 43.62 mm and INF shall check the level of harmonics expected on this reference radius. LFI mentioned that the correction factor due to thermal shrinkage of the shaft is considered into the calculation from warm to cold extrapolation. At room temperature the shaft shall be aligned through dedicated flange.

As during the warm magnetic measurement, it is expected a b2 harmonic value up to 200 units, some sensitivity analysis are recommended to understand what is the impact of deviations.

AI-5 : INFN to check the level of harmonics at the shaft reference measurement radius with sensitivity analysis.

Schedule:

INFN confirmed that in a the best scenario Short model could be delivered end March 2018 to CERN but due to on going procurement delays and contingencies during production, the late date shall be May 2018.

HBS confirmed that a notice of 3 months is requested to confirm delivery date and reserve test cryostat.

INFN confirmed that due to the D2 coil topology, only one aperture needs to be measured at cold.

PFE requested to include the warm measurement in the test plan to correlate CERN measurement with manufacture warm measurement performed by ASG company.

Instrumentation

INFN would like to agree on the scope of EN MME onto the installation of sensors before making the expected amendment of Short model contract.

Strain gages: EN MME presented usual assistance in the selection, sensor installation, data acquisition of SGs on magnets. INFN is interested in such direct collaboration so that the additional instrumentation is managed by INFN through such external contract. The DQA system used by EN MME is based on lock-in with AC signal and 2 microstrains accuracy.

Budget proposal of strain gages on D2 Short model is as follows:

- 6 Rods of 4 SG : 24 SG + 36 cables (full bridge /rod)
- 12 bullets of 4 SG : 48 SG + 72 cables (full bridge / bullet)
- 4 Collars of 4 SG : 16 SG + 40 Cables (2 half bridges per collar)

  Total : 88 SG + 148 Cables

AI-6 INFN to propose a scheme of collaboration with CERN EN MME to install and perform measurements of related D2 instrumentation in relation with contract amendment– Jul’ 2017

Bullet gauges: MGD recommended bullet gages instrumentation with 4 strain gages installed on an intermediate pin. EN MME proposed to fabricate and instrument the D2 bullets. For the D2 there is a total of 12 bullets for two apertures. 6 wires are used per full bridge

AI-7 HBS to send drawing of actual 11T bullet gauges design to INFN for redesign – end June’2017
AI-8 HBS to send the cabling layout of the cluster D lambda plate connectors – july 2017

Instrumented Collars: The strain gages wires routing towards the outer collar and yoke shall be checked by INFN. The stress analysis performed by INFN shall help to determine location of gauges. The strain gauges installation, thermal cycling on the specific 4 selected collars can be done by EN MME, to be decided by INFN.

AI-9 INFN to communicate the stress results on the collars noses during the cool down and energisation – Aug 2017

Aluminium rings: AFT suggested to instrument one or two aluminium ring to check level of stress with respect to design value at cold and operation

Quench heaters:
The QHs power supply output voltage is rated at 0-900 V and CERN shall check the recommended test voltage of coil. Only 4 circuits of QHs shall be operated at a time with limited configuration for fault scenario tests

High voltage tests
The high voltage testing level of 5kV DC to ground was discussed with INFN which is performed before shipment.
The high voltage tests are repeated on the magnet at delivery at SM18, once installed in the cryostat, after the cool down.0

Temperature sensors:
It was discussed to install one sensor at each extremity of the cold mass to check thermal gradient during cool down

Voltage taps:
INFN has shown the expected the 32 VTs (12 on splices and 20 on CS head turns) installed onto the 4 coils of the two aperture.
AI-10: CERN to communicate to INFN any procedure details on how to install the VTs between turns blocks in the NbTi coils heads. – Aug 2017

Super bolts on structure :
INFN has shown the proposal of tensioning super bolts (M24, M33) used on the 6 tie rods, AFT mentioned that if retightening actions is needed, the access will be easier from bottom non connection side, once magnet lifted off the cryostat.

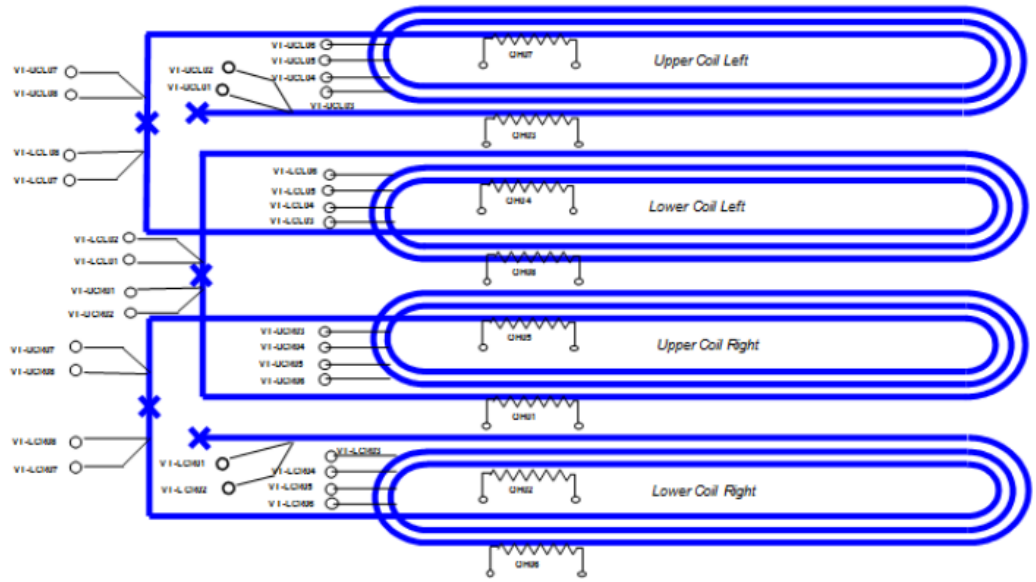

Fig.1 preliminary instrumentation scheme of D2 short model

Electrical Circuit inputs:

It was discussed that the first test sequence of the short model (inductance of about 4.9 mH) shall include a dump resistor of 20 mOhms (tbc). INFN will check the update discharge features of the coil in the new circuit in the various test scenario. The final test of the short model is planned without a dump resistor.

Optical fiber strain measurement
ACO presented the strain measurement Bragg Gratings optical fiber system with 16 channels, 1kHz sampling rate which has been used in particular on MQXFS on collar pole instrumentation. The outer diameter dimension envelop of the fiber is 1 to 3 mm which seems too tight to be integrated in the inner tube gap to the shaft wall. Lambda plate is equipped with cold Fischer optical fiber connectors.
One of the interest is to measure the strain along the coil during operation to check hypothesis of frictional model and the sharing of loads between collared coil and yoke. Some idea was proposed to instrument the 100 mm long pole segments with the fibers with an optimum number of gratings along the 2 m fiber of 5.
AI-11 ACO with NPY check and propose potential space to integrate the strain fiber to measure th longitudinal strain of one aperture. – Aug 2017

D2 short model test plan document

AFT presented the scheme of test plan D2 draft document which need to be iterated between INFN and CERN in order to agree on key parameters to be checked and sequences of various characterisation tests
AI-12 To iterate the D2 Short model test plan between CERN and INFN – End sept 2017