

## 10<sup>th</sup> SRF Collaboration Meeting @ LASA on June 25-26, 2019

**Time:** 09:00 – 18:00

**Chairman:** Paolo Michelato

**Secretary:** Christine Darve

**Attendees:**

Andrea Bignami	ESS	Guillaume Olry	IPNO
Christine Darve	ESS	Angelo Bosotti	IPNO
Nuno Elias	ESS	Giorgio Fornasier	INFN
Luca Sagliarno	ESS	Paolo Michelato	INFN
Cecilia Maiano	ESS	Laura Monaco	INFN
Paolo Pierini	ESS	Rocco Paparella	INFN
Felix Schlander	ESS	Daniele Sertore	INFN
Pierre Bosland	CEA	Mike Ellis	STFC
Enrico Cenni (VC)	CEA	Simon Gregory	STFC
Christelle Cloué	CEA	Peter Mc Intosh	STFC
Vincent Hennion	CEA	Mark Pendleton (VC)	STFC
		Paul Smith (VC)	STFC

Web link available at: <https://confluence.esss.lu.se/pages/viewpage.action?pageId=303519052>

### Agenda : June 25<sup>th</sup>, 10<sup>th</sup> SRF Collaboration Meeting

09:00-09:05 (5')	Welcome Conference room	
09:05-09:15 (10')	<a href="#">Minutes of 9h SRF Collaboration Meeting</a>	Christine Darve
09:15-09:45 (30')	<a href="#">Status of CEA activities on the SRF Cavities and Cryomodules</a>	Pierre Bosland
09:45-10:05 (20')	<a href="#">LASA - Status for Medium-beta cavity fabrication &amp; testing and open issues</a>	Paolo Michelato
10:05-10:25 (20')	<a href="#">STFC - Status for High-beta cavity fabrication &amp; testing and open issues</a>	Mike Ellis
10:25-11:05 (40')	Coffee break	
11:05-11:20 (15')	<a href="#">IPNO - Status Spoke cavity series</a>	Guillaume Olry
11:20-11:40 (20')	<a href="#">ESS - Status of activities at ESS (Test Stand 2 &amp; etc.)</a>	Paolo Pierini
11:40-12:00 (20')	<a href="#">ESS - Status of cryomodule tunnel installation</a>	Felix Schlander
12:00-12:20 (20')	Discussion Synergy - Testing lessons learned from Spoke and Elliptical	All
12:20-13:25	Lunch (and buffer..)	
13:25-13:45 (20')	<a href="#">ESS - SRF frequency database</a>	Cecilia Maiano
13:45-14:05 (20')	<a href="#">LASA - Status of cavity documentation, fabrication, inspection and NCRs</a>	Laura Monaco
14:05-14:25 (20')	<a href="#">CEA - Status of cavities documentation and NCRs</a>	Vincent Hennion
14:25-14:45 (20')	<a href="#">STFC - Status of cavities documentation and NCRs</a>	Mike Ellis
14:45-15:05 (20')	<a href="#">Vertical test at STFC</a>	
15:05-15:25 (20')	Break	
15:25-15:55 (20')	<a href="#">ESS – Cryomodule and Cavity Documentation – Declaration of conformity</a>	Fredrik Håkansson
15:55-16:55 (60')	Discussion session (Flow of Documentation, DoC, etc)	

### June 26<sup>th</sup>, Workshop based on 10th SRF Collaboration Meeting and ESS Visit

- NCR defining and handling
- DoC: Documentation for declaration of conformity

## Minutes

### 1 Welcome (P. Michelato)

Paolo Michelato welcomed the guests to the 10<sup>th</sup> SRF Collaboration Meeting in LASA-Milano.

### 2 Minutes of 9h SRF Collaboration Meeting (C. Darve)

All action items are continuously addressed during the weekly SRF collaboration meetings, held via Vidyo conferencing every Fridays at 10:00 [ESS/SRF Collaboration](#).

Follow-up of specific action items, referred in the MoM of 9<sup>th</sup> SRF collaboration meeting, held in ESS:

Action 1: CEA to send the list of tooling and procedures to complete the alignment measurements.  
→ closed (Michel Fontaine/CEA visited ESS in March to share experience.)

Action 2: LASA to limit the delay in cavity production due to Zanon (EZ) furnace non-availability → closed (IPNO and RI supported these activities).

Action 3: Solve the insertion of the valve orientation in the vertical cryostat. → closed (STFC and CEA agreed on design change)

Action 4: Understand the discrepancy in HNOSS measurements → closed (P01 has been re-measured with same Eacc at CEA, before and after UU test).

### 3 Status of CEA activities on the SRF Cavities and Cryomodules (Pierre Bosland)

Pierre gave the status of the series cryomodules procurement and the assembly progress for CM01.

The M-ECCTD has been shipped to ESS in January 2019 after being tested in CEA-Saclay till December 2018.

The complete test report is still to be sent to ESS. Even if periods of stability have been limited, the static and dynamic heat loads have been measured. The measured RF dissipation was 4.5 W per cavity (requirement < 5W). The operation instability was mainly due to the Hampson (series) heat exchanger, not used in supercritical helium environment at CEA. In addition, the position of the Liquid helium gauge was too low and was not corrected to have the proper monitoring of LHe level.

The assembly of series cavity string and its cryomodules by the B&S team, is on-going, after delay due to Ti bi-phasic line welding (welding head and weld qualification).

For H-ECCTD, the last cavity HB01 to be assembled, has been tested in vertical test and shows a poor performance (< 9 MV/m) ! An additional flash BCP/HPR is planned by EZ on July 8<sup>th</sup>. The 3 other HB cavities are assembled to their power-couplers and are waiting in the CEA clean-room.

The different Non-Conformities have been listed, analyzed and lessons learned transmitted to LASA and the fabricant.

#### → Action item:

1. Request by CEA to Shorter GHe exhaust of the helium tank for Hb cavities.

#### 4 LASA -Status for Medium-beta cavity fabrication & testing and open issues (P. Michelato)

Paolo M. summarized the status of the Mb cavities preparation, from the Nb sheets scanning till the cavities sent to CEA after test in DESY. The [Status matrices for Elliptical Cavities and Cryomodules](#). Only one sheet rejected and one re-worked. All subcomponents are fabricated.

After the test of the first 4 cavities, the spec. nominal frequency is 704.150 MHz (-0.15, +0.10). Four more cavities shall be tested in the coming month in DESY.

Vibration test has been conducted and shows improved acceleration damping for cavity transportation boxes, w.r.t XFEL lessons-learned. 30 cavities transported so far using the same XFEL transport means.

Analysis of the pitting effect on-going (e.g. 20 microns on M006, limit at 18 MV/m).

The EZ oven requalification is almost complete (w/ Polytech. Milano) after last year accidental venting IPNO and RI ovens permitted to prevent project delay and strengthen our collaboration.

Medium-beta CEA, P05 cavity has been used as a reference to compare the test stand results. It shows 20-30 % of result difference btw DESY and LASA. P05 cavity will be sent to CEA, then to STFC (after flange welding) to complete the comparison.

##### ➔ Action item:

2. LASA to send P05 cavity to CEA for test stand comparisons (then STFC)

#### 5 STFC -Status for High-beta cavity fabrication & testing and open issues(Mike Ellis)

The first High-beta cavity, bare H001, has been tested in DESY vertical pit. The new process of RI bulk BCP is proven promising.

Test results are good: 21.62 MV/m, Q0 1e10, No FE, no harmful HOM according to Mamad and Enrico. Measured 125 W total power, in agreement with the expected value.

At RI 54% of the sub-components are fabricated.

STFC supported by CEA and RI, have improved their interpretation of NCR and set internal NC handling (e.g. 54% of half-cell are out of tolerance, but OK for CEA.) So far 3 NCR have been reported to ESS, regarding the end tube for very small dimensional off-tolerance (< 5 microns).

Prototype high-beta cavity (earlier design), P02 has been used in STFC to validate the new Vertical Test. Good cryogenic stability is obtained, +/- 0.1 mbar. The results are in agreement with CEA results (within 5% Eacc). Very high measured radiation value due to high FE, limited the possibility to reach high gradient. STFC used 6 RP probes, incl. some probes located by, and perpendicular to, the axis of the cavity. The energy spectrum detector are not working yet.

More test will be conducted with 2 cavities (P01 and P02), then with 3 cavities (incl. H001).

#### 6 IPNO - Status Spoke cavity series (Guillaume Olry)

Guillaume presented the status of the 29 series Spoke cavities ordered at EZ and the preparation and test of double spoke cavities at IPNO. 16 (incl. 4 pre-series) DSPK cavities are already delivered to IPNO. The vertical test produces throughput of appx. 2 cavities tested every month. See status at: [Status matrices for Spoke Cavities and Cryomodules](#)

A “huge” leak has been detected on DSPK08 between the Helium vessel and outside/ambient. Causes: 1) incident while drilling; 2) No step was completed to check DSPK08 existing leak before the cavity delivery (in order for IPNO to save time...). Consequences: 1) Cavity rejected and sent for repair to EZ. 2) Modification of the life cycle of the cavity V1.8 (March 2019).

Cavity frequency shifts at delivery vary from 351.383 to 351.667 MHz. The mean values over 14 series cavities is -435 kHz, 8 cavities fully BCP-ed.

Vertical test of series cavities up to 19 MV/m. Field emission limits accelerating grading above 11 MV/m (spec =9 MV/m), but the cavity frequencies were too high. Hence, only 2 cavities are within specifications.

## **7 ESS - Status of activities at ESS (Test Stand 2 & etc.) (Paolo Pierini)**

Paolo P. presented the status of the ESS SRF activities, using the presentation prepared for the SRF 19<sup>th</sup> conference to happen in Dresden beginning of July. The sequences and data flow were summarized, from the IK partner fabrication till the tunnel installation. HDF files and scripts are created.

Transfer of ownership from Skanska to ESS is progressing for the gallery and the tunnel. So far, 12 valve boxes units have been installed in the ESS tunnel and connection between CDL lines is progressing.

The local SRF laboratories capacity was described as well as the tools (i.e. transportation trolley, DK assembly tools) and support posts for the cryomodule installation.

## **8 ESS - Status of cryomodule tunnel installation (Felix Schlander)**

Felix presented the work completed and in preparation for the cryomodule installation in the tunnel and the gallery. 480 holes have been drilled to welcome the cryomodule support posts. See pictures of installation sequences.

## **9 ESS - SRF frequency database (Cecilia Maiano)**

Cecilia presented the high level ESS test plan. The database for frequency measurement and the architecture for the data storage have been presented. The analyses of the measurements (e.g. bandwidth, field flatness, cold spectrum, RF calibration) were summarized. Python is used for the program.

The test plan was introduced (i.e. cool-down, low and high power RF test). Hence the component performances, the limiting mechanisms, comparisons (with VT) and data storage for future linac operation will be possible thanks to the TS2 operation with RF to start after the SSR, expected on August 29, 2019.

## **10 LASA - Status of cavity documentation, fabrication, inspection and NCRs (Laura Monaco)**

Laura presented the status of the cavity documentation, inspection and NCRs observed. Snap shots extracted from Alfresco showed the QC management w.r.t. the given acceptance levels (AL1,2,3 at EZ). Ticket systems are issued to permit a fast communication with EZ and DESY. Inbox and Outbox are used to communicate, as well as automatic process whenever possible.

The order of magnitude of documentations is very large (AL1~56, AL2~54; AL3~58). Non Conformity reports (NCR) were summarized using reference cases. There can be up to 1000 documents to be created.

The NCR tracking will gather every email communications on a given NC item. NC with impact on the interface with CEA assembly are sent to ESS for approval. 20 such NCR have been identified.

### 11 CEA - Status of cavities documentation and NCRs (Vincent Hennion)

Vincent summarized the changes in the cavity fabrication dwg based on the medium-beta lessons learned. Those include 1) the helium tank length relaxation; 2) the cavity identification engraving; 3) Hb outlet of the biphasic line length (from 305 to 255 mm); 4) acceptable torque on M8 screws (Max torque = 27 N.m).

### 12 STFC - Status of cavities documentation and NCRs (Mike Ellis)

Mike summarized the documentation data management (via SharePoint) and the different non-conformity reported (NCR) for the first high-beta cavity fabricated. Level of acceptances are organized the same way than for the Medium-beta and automatic workflow is possible.

The cavity sub-components and components fabrication are tracked in accordance with the sounds engineering practice (SEP).

Based on the example of H001, up to 100 documents per cavity were issued for AL1 (db to cavity); up to 5 documents for AL4 to be shared with ESS.

SuRF lab data are stored and reports are generated automatically for the measurements.

### 13 Vertical test at STFC (mike Ellis and Mark Pendleton)

Mike summarized the results obtained using STFC VTF infrastructure and Process, on behalf of Mark. Cryogenic performance was measured on P02. The pressure and temperature stabilities were very good ( $\pm 0.1$  mbar,  $\pm 1$  mK). The results obtained for P02 are identical to those obtained at CEA.

STFC testing was limited by RP issue (location of office space and high emission P01). Radiation survey and gage position were shown (much closer to radiation source than CEA). H001 should not have as much emission.

Up to 3 cavities every 2 weeks are expected to be tested.

The clean room building is completed and the UPW (ultra pure water) system installed. HP work to be completed on July 8<sup>th</sup>. HPR over the last 2 weeks.

The orientation of the series valve and the SuRF lab commissioning schedule were explained. CSI company prepare the cavity in the insert.

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### June 26<sup>th</sup>, SRF Workshop based the 10<sup>th</sup> SRF Collaboration meeting presentations

- The focus has been on sharing examples, template, platform use, for the data documentation from LASA to CEA/ESS.

STFC needed some examples to benchmark and tune these own SharePoint structure and data management. See List of documents (AL5) in the our web section Integration (as presented by Laura on June 25, based on EZ input and Alfresco).

Daniele shared with Mike the script and the organization of the Medium-beta cavity measurements.

- A second point was the status for the Declaration of Conformity: SEP is applied by fabricants (EZ and RI); all fabrication document are tracked; Certification (Welding, Nb, etc..) from EZ and RI are being collected. Relevant DoC folders will be built. SEP will be referred on the marking plate added on each vacuum vessel.