**ESS Bilbao Visit: 30-31 May, 2018 RF Workshop in ESS Bilbao**

**Indico page:** <https://indico.esss.lu.se/event/1053/>

**Video connection:** <https://vportal.esss.lu.se/flex.html?roomdirect.html&key=eBQ1Px70x1SRhgFGMtzZioIOM>

**AGENDA**

**Attendees:**

Morten Jensen Pedro J. González

Stevo Calic Nagore Garmendia

Bruno Lagoguez Arash Kaftoosian

Anders Svensson Oscar González

Rafael Montano Iñaki Barrera

Chris Amstutz (remote) Miguel Alarcón

Chiara Marrelli (remote) Mario Pérez

Anders Sunesson (remote)

Anders J. Johansson (remote)

**30 May 2018 (UGALDEGUREN,** [**https://goo.gl/maps/QfuWH3A2jWw**](https://goo.gl/maps/QfuWH3A2jWw)**)**

**9:00-9:15 Welcome**

**9:15-10:30 RF Systems Project Status (separate meeting)**

M. Jensen, A. Sunesson (remote), P. González, M. Pérez

Planning, call for tenders, scope swap

**SSPA tendering (separate meeting)**

B. Lagoguez, A. Kaftoosian

Evaluation of technical proposals

**RFDS-RFLPS (separate meeting)**

R. Montaño, S. Calic, N. Garmendia, O. González

Signal conditioning board, arc detectors, power detectors

**LLRF (separate meeting)**

A. Svensson, M. Alarcón

LLRF Hardware

**10:30-11:15 HPA Status (Klystrons, Drivers and SSPAs)**

10:30 -10:45 B. Lagoguez, C. Marrelli

10:45 -11:00 A. Kaftoosian

11:00-11:15 Open discussion

***11:15-11:30 Coffee Break***

**11:30-12:30 RFDS Status (Waveguides, Circulators and Loads, Coax, Mechanical Supports, Arc Detectors, Power detectors)**

11:30-11:45 S. Calic

11:45-12:00 O. González / I. Barrera

12:00-12:30 Open discussion

**12:30-13:30 LLRF Status (LLRF for NC and Spoke, LO Distribution)**

12:30-12:45 A. Svensson, C. Amstutz, A.J. Johansson

12:45-13:00 M. Alarcón

13:00-13:30 Open discussion

***13:30-14:45 Lunch***

**14:45-15:45 RF-LPS Status (SIM, FIM, SCB)**

14:45:15:00 R. Montano

15:00-15:15 N. Garmendia

15:15-15:45 Open discussion

**15:45-17:00 Installation (Diagrams, Layout, Cable Lists, Racks and Rack Mapping)**

**20:00-22:00 *Dinner***

**31 May 2018 (ZAMUDIO,** [**https://goo.gl/maps/SU6DDdUSfsJ2**](https://goo.gl/maps/SU6DDdUSfsJ2)**)**

**8:30-8:45 Welcome**

**8:45-9:15 Visit to RF Test Stand (N. Garmendia/M. Alarcon)**

**9:15-11:00 Separate Meetings (TBD, as required)**

***11:00-11:30 Coffee break***

**11:30-12:30 Close-out Discussion, Conclusions, Actions and Next Steps**

***12:30-13:30 Lunch (flight departs at 14:55)***

**30 May 9:15**

Pedro, Mario, Morten, Anders Su (remote), Mats (for summary)

*Presentation by Pedro on status:*

The klystron which has a micro leak to be sent to CPI. It is currently still at ESSB waiting for the contract for the repair and warranty extension to be prepared. Template for tendering is not yet available so the contract will most probably not start for 2-3 months from now.

The vacuum level of the other two klystrons is OK.

Last Friday CPI authorised ESSB to start the reconditioning. CPI will send a field engineer at some point.

The tender documents for the three new klystrons have been sent to the State lawyer (SL).

The ministry has now agreed to review SL support with the option to have one additional lawyer available to allow for a faster turn-around.

The tendering of the three additional klystrons has to be approved by the Executive Committee (steering committee = Spanish governing board).

The SSPA award is expected to be finalised by mid June with a contract signature by 1st July.

The tender for klystron drivers is currently on hold due to other higher priority activities at SL. There may be a possibility to increase the number of drive amplifiers to be able to provide 1-2 spare amplifiers. This would increase the value and will be considered in the discussions relating to the possible of scope swap between ESSB and ESS.

*High Power Circulator and Loads:* The procurement is an Open Procedure, launched 18th Feb. Only AFT bid, but the price offered was above the max. budget estimate set in the call for tender which means immediate compulsory rejection. The delay is estimated to be 4 months, approximately the time to launch a new tender. The target contract date would be mid November. The manufacturing time for first unit is expected to be 9-10 months. Delivery therefore would not be before October 2019.

The value of the waveguide tender is estimated to be approx. 1M EUR and is currently under review with Lawyer.

*Mechanical Supports:* Considered an option possible for scope swap. The value of a is approx 45-50 kEUR. Due to the current procurement limits this means that it has to be approved by the SL. Three quotes have already been received. All are below 50k EUR. The delivery time is estimated to be 4-5 months from signature of contract. Contracts could be signed by mid-October, which would ie delivery March 19.

The mechanical supports are predominantly to support the waveguide components, RF loads and circulators for the RFQ and the 5 DTL tanks, however they will also support the pipework and electrical installation including cable trays. Therefore the support structure is urgent as it is a pre-requisite for the utility installation.

The mechanical design has been completed by Inaki and integrated by Pontus. However the ESSB model reviewed is not the latest model of the RFQ/DTL area and the CHESS model and drawings do not appear to be up to date.

**Action 1** : Check that Inaki and Pontus have the designs aligned.

**Action 2** : ESS numbers and layout to be made available in CHESS and confirmed to be the latest version.

**Action 3** : ESS to supply drawing of hole pattern and mechanical interface of the pieces of waveguide which will be used for the stub cooling.

**Action 4**: ESS to review connection/flow of waveguide cooling after the magic T moved to the gallery.

The order for the 1 5/8 coaxial line could be placed in a couple of weeks since the value is be below the threshold for SL approval.

**Action 5:** ESSB to confirm when the order has been placed.

The LLRF and LPS procurement by ESSB should be started by the end of summer 2018.

*Scope swap:*

The items which have been discussed between Anders Su and Pedro were summarised. The scope swap includes items which could be supplied from ESS under existing framework contracts to be offset by new scope from ESSB, predominantly spares as well as a possible loan of an existing circulator.

The load and circulators which could be lent to ESS by ESSB have only been low power tested and would need to be high power tested prior to installation.

Options:

**Action 6:** MJ find out if there are 3MW circulators at CERN.

**Action 7**: ESS to consider to take in-house the mechanical support structure with the view to achieve an earlier installation. ESSB to send procurement documentation. The documentation is in Spanish however the technical section could be translated to allow ESS to start procurement asap. There was a design element included in the ESSB contract. ESS to consider a build to print with some design elements including load calculations.

*Loads and circulators:*

**Action 8**: ESSB to check if the number of items in the load/circulator base tender can be reduced with options to add more units later.

**Action 9**: ESS to investigate how quickly ESS could procure. 1 circulator and 2 loads is approx. 150 kEUR.

The target date to be achieved for all systems was discussed and it was confirmed that we should aim to have the RF system required for the RFQ commissioning ready not later than February 2019. This includes all systems (in WP8) required to deliver RF to the RFQ flange.

To reduce the risk of changes in the design or specifications having been missed all the specifications will be re-checked by ESS.

**Action 10:** Pedro to make all tenders specs available for review immediately.

**HPA klystrons**

Arash: See presentation

SSPA: The tender for 3x30 kW was published and closed on 23/4/2018.

5 offers were received however three had missing information. Following a further request for information, only two (2) offers remain (BTESA and TTi).

First unit to be delivered April ‘19

Drive amps for klystrons: 6 units plus maybe 2 additional units (scope swap). All docs are ready to be published.

The reconditioning of the existing klystrons to be delivered to ESS for long pulse operationis expected to complete by Q3/4 2018 at which point they would be ready for delivery to Lund.

Although the focus of the reconditioning exercise is to ensure that the klystrons will operate with the longer ESS pulse, the most relevant parameters of the klystrons, such as gain and signal purity, will be reconfirmed.

Descrepancies of the klystron interfaces were identified and all electrical and mechanical interfaces will be double checked for compatibility. (Water and electrical interface is to be corrected, see mail from Chiara on 13 February ’18)

**Action 11**: ESS and ESSB to reconfirm all electrical and mechanical interfaces.

**RFDS:**

3D layout was done by Inaki and should have been integrated by Pontus.

The layout has been fixed. It was noted that the drawings and screenshots on CHESS and Confluence were out of date.

**Action 12**: Check that the latest 3D model has been integrated by Pontus? What is the name of the 3D model and associated drawings?

**Action 13**: Arrange for review of 3D model at ESS and check for clashes.

**Action 14**: ESS to review waveguide specifications.

The waveguides would be manufactured and delivered in two parts. The first part is planned to include stubs 100 and 110 and the RFQ chain. The second part is to include the rest of the distribution.

**Action 15**: ESS to confirm the thickness of the concrete slab and the length of the anchors to be used for the mechanical support structure.

**Action 16**: ESS to confirm the pipe loads and position.

Stub drilling and hole position is already available but the final installation sequence has to be confirmed. Missing items include the internal stub lift. It was made clear that the design by Inaki is only valid if his installation sequence is followed.

It was agreed that a stub trial would reduce risk and should be carried out. A preliminary target was to carry out the stub trial in stub 100/110 in last week in August. ESSB will attend. The virtual installation and installation sequence to be confirmed by end of June. There could be a possibility to carry out a stub trial in stub 120 if the existing tooling there could be used.

**Action 17**: ESS to consider if the installation can be tested in stub 120 instead earlier.

**Arc detectors:**

ESSB advised that the preliminary cable list includes both CERN and AFT arc detector types.

ESSB confirmed that the gallery will use the Microstep CERN design for all locations.

**Action 18**: ESSB to send schematic of proposed locations for arc detectors.

RFQ and DTL will use AFT type in the tunnel.

ESSB (FIM) will take care of the arc signals from both sides of the cavity couplers.

**LLRF:**

RTM: 352 Downconverter: Version 12 at ESSB. Documentation only available for V11. ESSB have asked Struck regarding the documentation but no new documentation is available.

**Action 19**: Anders Sv will ask Mattias (at Struck) for an update.

ESSB have the minimum list of equipment needed to set up a basic configuration to run the LLRF.

AMC CPU: ESSB is using the ‘Powerbridge’. ICS is using a card from ‘Concurrent’.

**Action 20**: ESSB to ask Simone for confirmation of which CPU is the ESS standard.

*FPGA:* Weekly meeting with Chris takes place. Several releases of FM is available for upload. There are currently Issues with the driver. ICS is needed to support with this.

**Action 21**: ICS to confirm names of contact persons (discussions with WP8/ICS to address this have started).

The Linux driver should be working but the EPICS driver is not yet available. The driver currently being used is from the repository. The intention is to replicate at ESSB the full setup including drivers which will be in use for TS2.

**Action 22**: ICS to confirm coordinator to support with the integration with EPICS. Maybe it would necessary for somebody from ICS to come to ESSB to support.

WP8 has the same issue with coordination. The expectation is that as soon as everything is in E3 the majority of the issues will be solved. This is expected to take 2-3 weeks. At that point we plan to freeze the versions and further developments will have to be tested and coordinated.

**Action 23**: ESS will meet with ICS to discuss service needs and points of contact. This will be followed up with a call with WP8/ICS/ESSB to review support needs and priority.

There are some other LLRF adaptations which could be started before the ICS support on EPICS integration is available. This would include the RFQ and DTL adaptations.

The LLRF team (WP8), will support ESSB to start to study and develop the necessary modifications for the DTLs at soon as possible. At lot can be done already now, even without the detailed knowledge of the algorithms, as it revolves around data transfer and synching of data streams. The general shape of the algorithm is also known.

This can start this as soon as Bilbao has the necessary personnel resources available.

**Action 24**: ESSB to indicate when and what support from WP8 is required. This is to be addressed during the LLRF weekly meetings.

**Action 25**: Chris and Miguel will start to discuss the DTL algorithms and their development.

**Action 26**: Details regarding the DTL algorithm is also outstanding. This will be raised at the next LLRF call.

RFQ: Janet in contact to provide pick-up signal analysis. No changes in the RFQ FPGA.

**Action 27**: For the DTL ESSB needs a contact person (from INFN ?) who can provide information re. signals for FPGA analysis/processing. ESS to provide.

**LO Generation and Distribution**

The design will be largely based on surface mounted components.

The place of manufacture to be confirmed. It has not yet been decided if this will be internal to ESSB or through a subcontract.

The current design has 9 LO boxes in total. 1 for RFQ (needs 4 outputs), 1 for MEBT (needs 3 outputs)+DTL (needs 3x5 outputs), 7 for spoke. The design would require a 1:5 splitter.

Instead ESSB propose to have 10 LOs may achieve a better configuration 1 for RFQ (4 outputs), one for MEBT (with 3 outputs), four for DTLs (15 output are required ie needs 4x4 with one output not used), spoke is unchanged. This layout would require 1:4 splitters. ESSB considers this proposal to be easier and cheaper with components available of the shelf. This is the proposed solution from ESSB.

**Action 28**: ESS will consider and provide a formal comment back regarding the LO configuration.

**LPS:**

ESS provides the hardware for the MEBT LPS. Some IOxOS hardware is/was not fully available.

By the end of this year one complete system for RFQ and one for buncher (MEBT) must be available.

Signal list and interface for example to MPS are not clear.

**Action 29**: Full RFQ, DTL and MEBT signal lists to be confirmed. The signal list shall include all signals including MPS, temperature/cooling for the RFQ and buncher.

**Action 30**: ESSB to provide signal lists for review. ESS to review.

**Action 31**: For each signal, the physical interface/connector will be defined.

*Status of the conditioning boards*: Electrical schematics and BOM for digital and analogue boards are available. Schematics are for one channel and the sub contractor would need to duplicate for multiple inputs. ESS has a box and a board but they have not yet been put together and tested.

It is likely that the the mechanical installation for the analogue inputs could be improved.

The Atomki design has been tested.

**Action 32**: ESS to send ESS design and will also ask Atomki to send full Atomki design for ESSB to use.

**Action 33**: In the meantime ESS will send the digital and analogue prototype boards to ESSB.

**Action 34**: ESSB to decide and inform which design will be adopted and how it will be manufactured/procured.

ESS may have some spare e-pickup, a PSS relay and possibly PIN diode boards. ESSB to determine if they would like them sent out.

**Action 35**: ESSB to confirm if they would like the e-pickup, PIN and PSS boards for testing.

ICS is providing all hardware for interlock module: incl. crate, CPU, MCH and IOxOS board for the MEBT. ESSB felt that they had to deliver the IOxOS board 1410, but now the 1410 is an in-kind instead.

**Action 36**: ESS to confirm who provides the IOxOS IFC1410 boards.

For RFQ and DTL ESSB will deliver everything.

The MEBT is under a different TA and the hardware would be free issued from ESS.

**Action 37**: ESS/ESSB to confirm/agree on hardware BOM for the LPS and who provides what.

**Action 38**: Determine who provides and who pays for the MEBT hardware (between ICS and WP8).

**Action 39**: ESS to determine who provides e-pickup, pin diode, PSS switch, splitter. Check against the total being provided.

**31st May:**

The 3D integration and layout was discussed but the model was not the latest so a thorough review could not be completed.

The main issue is how the information is frozen and how to get the drawings updated and drawing numbers distributed.

*Stubs*:

The lift needs to come in different sizes to be able to access the coax lines and the initial waveguides. Installation is from the top to bottom and the side towards the ion source first.

The supports can be Hilti or similar.

The coaxial design and installation is considered low risk compared to the rest of the stub waveguide installation. Coax installation is installed first.

**Action 40**: ESSB to provide installation and cleaning instructions for the coaxial lines.

Anchors have been confirmed and approved by Mats P. previously.

Three (3) N-type to 1 5/8 transitions will be provided by ESSB.

**Action 41**: Consider a trial coax build on the floor first, characterise and benchmark at low power ahead of the stub installation.

The installation sequence of the waveguides will determine the tooling required.

**Action 42**: ESS: The electrical containment design for stubs 100/110 needs to be confirmed.

**Action 43**: Investigate the need for additional coax supports at the exit of the rack, in G02.

**Action 44**: ESSB to provide short circuit for each switch.

**Electrical Schematics**

**Action 45**: Check for feedback for the ESSB cable list. Did Staffan make any changes?

e-plan: To be outsourced. ESSB will review the updated schematics.

**Action 46**: ESS to confirm naming of devices.

**Action 47**: ESSB to send first version by end of July with the view to have it refined by end of August.

*Racks*:

**Action 48**: ESSB to send latest rack layout for all racks for RFQ, DTLs and MEBT for ESS to confirm that the racks exist, have been allocated and are available.

It was considered that a follow up meeting in approx. 3 months would be beneficial.

**Action 49**: ESS to set up a follow up meeting in approx 3 months (i.e. September)

The meeting finished with a visit to the test stand.

**Summary Action List:**

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