DH/20240507

# Minutes of the OEC loading discussion in Lecce 07/05/2024

Agenda and slides at https://agenda.infn.it/event/40809

## 1 Half ring for SR1 slice test

Ben presents some slides on the plans for the half-ring that will go to the slice test in SR1. The PRR is currently set for January 2025; this should include results from the combined slice test. This half ring will be needed earlier than those produced at other sites (4 should be made in total), and is planned to be built at RAL.

The reception test setup at RAL is presented, highlighting the lack of MOPS HUB and that the interlock has not yet been set up. Preparations are in process to load a digital ITkPix v1 onto an old half ring for low-power tests. They have a pre-production quality half ring without bus tapes. Ben highlights that he does not believe final drawings of the half-rings (with modules) are available; these will be needed to load in the correct positions.

For pre-production the pigtail alignment issue is highlighted: we cannot assume that the bus tape will be in the correct position, and the version of bus tape currently available does not have much tolerance to misalignment. For the slice test half ring RAL plans to use a side-on camera and place modules with the power pigtails attached; they will move modules to make sure that the pigtails can be soldered and connected. It is unclear whether the other 3 pre-production half rings will have new or old bus tapes; it is suggested that they will still have the old bus tapes. Paolo believes that v6 bus tapes only exist for L4 half rings; L2 and L3 will likely have older bus tape designs. There is a little bit of discussion about how feasible it is to align modules to the bus tape soldering pads, and surveying the ring before loading. It is expected that the pre-loading survey will be used to correct the module placement position, though of course this is a little counterproductive for a PRR.

There is currently no jig at RAL for the pigtail soldering. This should be provided by Genova, along with test pieces to trial before the slice test half ring. There are a few things which have to be sourced/manufactured at RAL to go along with what is provided.

The post-loading test setup at RAL is shown, highlighting which parts are not available. In particular, new data adaptor boards are needed, the MOPS HUB and interlock are both needed, and the optobox has to be set up. CO2 is also an issue: a blow-off system will be used and many safety checks have to be carried out by an external company at RAL. It is feared that it may be a significant amount of time for this to happen, and is considered a major risk. For the MOPS HUB, RAL were not included in the common order and so do not have a system. They will need to be able to read out 3 MOPS chips simultaneously to have a full half-ring operational. There is uncertainty about the order status for the next round of MH4B (MOPS HUB 4 Beginners), and for single MOPS systems - effectively level adaptors. Helen is gathering numbers at the moment for these level-adaptors (but will not include CAN bus controllers). Simon adds that a single MH4B should be able to read 8 MOPS chips in principle.

Plan A is that RAL will build and fully test the slice test half ring. Given the worries about CO2, soldering and MOPS readout, plan B is that the ring will be fully loaded

at RAL: each module will be tested individually with the reception test setup, and the ring will then be sent to Italy for pigtail soldering and multi-module testing.

The timeline is discussed. An estimate of when things need to be ready is shown, indicating (for plan B) that the half ring would need to be in Italy before August, to go to CERN for the beginning of September. RAL should decide by the start of July whether they will be able to test the slice test half ring, otherwise they should inform Italy to test. It is highlighted that this means there are 2 months to load the half ring and to commission the test setup. We should ask the system test group what they plan to do and when; it is unclear when exactly they need the half-ring and what they will be able to do with it at that point. Paolo asks whether we should do the full half-ring testing at all, and whether that might be better to leave to SR1. Marianna comments that the slice test is intended to look at eg. grounding issues with all of the final services, and whatever DAQ is ready at the time. It is unclear what the status of things like twinax cables is. Andreas comments that delivering the slice test half ring to CERN earlier will help for DAQ development. Paolo brings up the idea of preparing 5 half-rings, with the purpose of building up DAQ experience at each loading site. It is commented that module availability will be limited, and even 4 fully populated half rings seems questionable at the moment. Oxford and RAL are close enough that the Oxford half ring could be tested at RAL, but this means sequencing the work. A partially loaded half ring seems more likely/possible.

# 2 Loaded half ring drawing set

Martin presents the updated technical drawings of the bare L2 half rings, highlighting the new tolerances of the mounting lugs. It is highlighted that the rotation of the lug is not defined, and that this affects the construction of the reference system during loading. Danilo comments that a final survey of the bare half ring might be used to correct the construction of the reference system separately for each half ring, since we use the alignment hole and not the mounting hole. The loading sites are not enthusiastic about this. It remains to be seen how big this effect will be in practice.

# 3 Plastic protection and PP0 support

Roberto freelances 3D-printing for the ITk. He goes through the module loading head which has been designed in Lecce. Danilo asks if the head actively adjusts to match the bare half ring surface. He comments that given we have glass spheres in the SE4445, we do not need to overconstrain the modules during placement, and as long as there is some compliance then you can just push the module and let it adapt to the surface. There is some to and fro, and questions about whether Lecce and Genova use the same flexible suction cups to provide flexibility to adapt to the glass sphere level.

Roberto then shows a potential 3D-printed support for the PP0. At the Italian sites it is proposed to place the final PP0 during testing of the half ring, and to keep this in place until integration on the half shell. This clips on to the handling frame and holds the PP0 from both sides. It would be unclipped after the half ring is mounted on the half shell.

# 4 QC and DAQ requirements for loading sites

Antonio presents some slides collating information from many people. He goes through the two readout schemes, comprising data adaptors and zaza boards followed by PP0 and twinax. The status of hardware in the UK and Italy is shown. Stage 1 of the DAQ preparations involves the use of YARR with FELIX hardware, followed by a modular system developed with FELIX cards to be used for the last part of LLS loading and system integration. Proposals for stage 2 are presented in greater detail; covering DAQ operations and expected features/interfaces.

The hardware used at different sites is shown, highlighting the different power supplies purchased. For DCS, there is a lot of experience with WinCC around. On the interlock side, the current matrix requirements are shown from EDMS document AT2-IP-ES-0017. There are some comments that there are several things in the interlock requirements that are perhaps not needed. There is also a short discussion on the TILOCK signal from the NTC of the last module in the SP chain; type 1 cables are planned.

There is a long discussion about DAQ software, WinCC, etc. General depression all around. Not much is ready to handle multi-module setups and it feels like efforts have not yet converged on producing a system which can be used for LLS testing in time for the PRR. Whether that is the case or not is not clear, but several people express this view. What will be produced is not clear; whether this will be DAQ interfaces in WinCC or APIs that allow the DAQ to interact with the DCS and hide WinCC from the user.

# 5 Finite element analysis of the full endcap

Mauro presents FEA results of a full outer endcap.

# 6 Action points

1. Technical drawing with modules positions to be sent round if they exist
2. Check whether the 3 non-slice-test half rings will have new or old bus tapes
3. The timescale for shipping the soldering jig and test pieces to RAL should be established, and it should be made clear which additional parts should be machined/sourced at RAL
4. Sites need to provide numbers for MOPS level adaptors
5. Ask slice test co-ordinators when they need the EC half-ring and what is planned to be tested
6. Find out more information on the availability of parts, in particular modules, and agree on the objects to be constructed
7. It should be understood what the integration sites need in terms of PP0 support, and what the handover from loading sites to integration sites will look like
8. The interlock matrix for the OEC should be defined, if it will not match what is currently in AT2-IP-ES-0017

9. An agreement on type 1 bundles (and connectors) needs to be reached soon and communicated to Stephan Eisenhardt, to ensure that these are produced soon

10. Status/plans for the DAQ should be followed up. In particular, the timescale for readout of multiple modules on a SP chain needs to be established, and the plans for software interfaces to the LLS groups need to be understood

**A follow-up should be arranged!**