# LHC RF Meeting

19th January 2007

Participants: Maria Elena Angoletta, Luca Arnaudon, Philippe Baudrenghien, Thomas Bohl, Olivier Brunner, Andy Butterworth, Edmond Ciapala, Wolfgang Höfle, Trevor Linnecar, Pierre Maesen, John Molendijk, Eric Montesinos, Daniel Valuch, Frode Weierud.

#### 1. UX45/RUX45/SR4 installation/commissioning (Olivier et al.)

Olivier made a comprehensive <u>presentation</u> showing present status and outlining the key points in forthcoming installation and commissioning work.

**4 ACS Racks:** Remaining activities are completion of the signal distribution system, HOM patch panels, access and beam dump chassis (to complete) and the LF multiplexing systems. The false floor will be installed in the near future.

**4 ADT Racks:** To complete: Multiplexers, RF cables (Jean-Claude) then final PLC software and network set-up (addresses) and again the false floor.

**HV Bunkers** – 60 kV testing is ongoing (2 bunkers now done). Crowbar triggering tests are being successfully carried out. HV tests will then be done from the surface. Water tests remain to be done; they will be followed by power converter tests. Remote DCCT calibration test and check of klystron earthing are ongoing. False floors have to be completed in the bunkers and holes have to be filled in before power tests.

**Faraday Cages:** Some flexwell cables remain to be connected to patch panels. Installation of VME crates, clock and timing distribution will be done as soon as equipment is ready. It may be best to do pre-installation of modules in the VME crates, before putting them in place (Philippe).

**Klystron zone:** The new cable sections (for w/g reflected power to Faraday cages) from the trenches to the platform will be installed next. Work on installing arc detectors and cabling is ongoing, then the interlock cabling to the waveguide shorts will be done. We do not yet have a fixed date for static pressure testing of the water circuits. There are large quantities of dust on the equipment; once all CV work is finished the zone will be properly cleaned up.

**Platform:** The HOM cable rolls have still to be made, then installed and connected. Cavity forward cables have been cut to length and the connectors will be mounted. Directional couplers and arc detectors are again being installed and cabled.

**Inter wall zone:** Arc detector cables need to be put in place. Spacers will also be put on top of waveguides to support the HOM cables, in order to avoid heating of cables or waveguides.

**Tunnel – RUX45:** The work on installation of the Warm Recovery Line (WRL) is progressing more rapidly than planned. The compressed air line is now in place, but not yet connected to the sector valves. Fitting of coupler mechanics on the modules and fitting of the waveguides can be done soon, but we may wait till the WRL work is complete. Installation and cabling of arc detectors is also needed. Calibration of antenna cables also needs to be done.

**4 ADT and APWs in RBs:** Amplifiers are still to be installed but this is not yet critical. In the meantime static pressure tests on the water circuits. Earth connections of the kickers have to be verified. A few damaged flexwell cables will need the ends cut and connectors re-fitted. The electrical distribution boxes are ready and can be installed. (Note: These will still have their own internal circuit breaker, without status indication; hence we will have to rely on other diagnostics to detect missing 400 vac.) Eric will organize installation of patch panels for Q7/Q9 pick up cables.

**SR4:** The control enclosure is in place, Jean-Claude will obtain an estimate for fitting a roof. He will also contact TS-CV on requirements for roof vents. We will need a GPS installation for the frequency synthesiser and this is being looked at by an outside supplier (not yet budgeted). An antenna is needed, we will check to see if use can be made the existing antenna – we believe there is one at each even point. Note that the layouts and cabling for diagnostics and ADT equipment need to be defined very soon to allow completion of a DiC and cabling work to be done.

General summary and planning: Cabling and electrical work are practically finished. Vacuum cryo and water cooling work should be finished in the tunnel areas by the end of February, allowing the roof blocks to be put in place. The metal floor plates in the UX45 transport zone will be taken away. (Note that all the magnet transport through P4 was completed without incident.) Ventilation system tests will follow. February will also see cable and antenna calibrations, power converter tests and PLC software upgrading for FESA 2.9. Klystron power tests will start in March some basic LLRF drive equipment will be needed for these first power tests. Cryo cool down preparation will start at the end of March.

## 2. ADT (Eric/Wolfgang)

**Amplifiers:** A first batch of four amplifiers has been fully tested. The total number to be tested is 20. We will now wait for reception of resistors and flexible water hoses, planned for April, rather than testing with the small number of parts we have and then removing them. Testing in the machine remains tentatively planned for September.

**Preamplifiers:** These are still under development (noise considerations)

**HOM loads:** Cabling will be organized by Eric.

# 3. ACS Couplers and SM18

**Couplers 131 and 134:** These have been fitted to the test cavity. There is a problem with the vacuum pump (oil leak) and we are discussing repair with the vacuum group.

**Single cavity module LHC21:** Conditioning to full field has proved relatively difficult, a good test however for the new conditioning system. Other LLRF tests are outlined below. We will keep the cavity in the bunker as long as possible to do tests.

## 4. LLRF

**Conditioning DDS module test (John):** Successful tuning of the pulsed cavity has now been confirmed in SM18. (An error in the conversion of the reference phase to required sin and cosine terms in the FPGA was corrected) This is particularly important for cavity conditioning to maximum field at high Q, especially in the machine where cryo stability may not be as good as in SM18. The gain of the tuning system was reduced to avoid excessive tuner activity. Automatic sweeping of the tuner and going to the resonance peak was also tested successfully. The GUI now displays peak vacuum over the measurement intervals.

**Set Point Module:** Two prototypes have been received from the design office. Unfortunately some FPGA pins have not been properly connected to the board. This could be checked by pressing on the chip and observing the behaviour of the VME interface. One board however appears so far to have only one pin open and a work-around has enabled tests to continue. The problem is due to use of lead-free solder on the connecting ball array of these components; the simple application of flux on the print is insufficient to make a reliable connection. Another set of three modules can be assembled in 2-3 weeks, probably one at a time, using a mask on the surface which allows a proper solder/flux mixture to be applied for mounting the lead-free components.

**Switch and Protection Module (Philippe)** First tests look encouraging.

**4** Multiplexing of SR4 signals (Philippe): The arrangement for multiplexing of signals from the tunnel and other SR4 signals and their connection to fibre optics links (e.g. for transmission to the CCC) has not been defined. This is needed to estimate how many fibre TX/RX systems need to be made and installed.

### 5. Controls, Diagnostics, Machine Protection (Andy)

**LF Multiplexing Systems:** Outputs have been allowed in various equipments for separately monitoring of a number of <u>analog signals (see list)</u>. However we have not selected equipment or done cabling layouts for these systems. In view of other priorities (e.g. fast acquisition for ADT) and the fact that many signals are already obtained by other channels, we may delay installation till next year, once some operational experience has been gained.

**Beam interlock signals:** We now have to decide our requirements on 'maskable' and 'unmaskable' inputs to the Beam Interlock System (BIC). Maskable interlocks can be inhibited by the operator below 3.5 mA beam current. (**Note:** previously discussed <u>LHC RF meeting 11 Feb 2005</u> and <u>LHC RF Meeting 18 Feb 2005</u>, where we decided "A list of interlocks will be made, with proposed maskable / unmaskable status for each, to be agreed upon and given to the Machine Protection team").

The <u>estimates for safe beam for warm SC cavities</u>, based on Joachim's calculations, put the safe limit somewhat lower, at 0.5 uA. This and the <u>options</u> for handling it were presented: either we connect a number of signals to the unmaskable input (ass originally proposed) or we rely on the software interlock system in the range between 0.5 mA and 3.5 mA. To be followed up before next week's meeting.

#### 6. AoB

**Budget follow-up**: Olivier showed the present <u>overall situation in January 2007</u> for the LHC RF budget codes. Some important miscalculations (in the wrong directions) had crept in to the expenditure on the installation and cabling codes. With this corrected (Nicole Polivka) we are on target to be within CHF 5000 of the cost to completion...

Errors and other adjustments occur often in EVM and can be difficult and time-consuming to follow up and correct. Since Annabel Cobas now has experience in this we will ask her to follow it up and report regularly, informing us of any anomalies.

Next Meeting: Friday 26<sup>th</sup> January at 08:45 in the JBA room.

E. Ciapala, 25<sup>th</sup> January 2007.