LHC RF Meeting

10th May 2007

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

1. P4 RF Installation/Commissioning

ACS HV and klystrons (Luca): All 4 klystrons for Module 1.B2 have been taken to 46 kV and 8 A. Voltage and current divider readouts have been calibrated at 200kW load per klystron. The values now agree with those measured by PO. The power converter can now be set correctly using the FESA connection. Initial problems with remote setting were due to incorrect (or missing) programming of the power converter's internal function generator. Tests are starting with RF, using a signal generator and temporary RF switch crate in the Faraday cage. At the same time tests on bunker equipment and klystrons for Module 2 B1 will be started.

ACS Modules & cryo lines:

- **Pressure tests and flushing:** Pressure tests to 25 bar have been done on the C D E and F cryo lines. The module inlets and outlets are not yet connected and the C and D line module valves were kept closed. Pressure tests on the modules will be done at 2.1 bar; one 2.1 bar release valve has been put on each module for the tests. The flushing process will follow, taking 3 weeks to complete Trapped air in the circuit is removed by alternately slowly pressurizing and pumping all lines.
- **Operating pressure of valves:** The preliminary analysis with Safety Commission and Cryo has been done. In spite of the 1.6 bar recognized design pressure, 1.8 bar can be confirmed as acceptable for all failure scenarios at cold. However this does not apply at warm, i.e. at the very start of cool-down. The solution is to have a 1.5 bar valve mounted together with one of the the normal 1.8 bar valves, switched with a manually operated 3-way valve. We will have to find the necessary parts.
- **Start of cool-down:** This is expected in Week 25. Note that RUX45 access will be restricted while this is in progress.

Vacuum work: Bakeout is continuing in the proximity of the ACS modules. Interconnects will be installed next week. The electron stoppers are not yet in place. Sector valves on the modules are closed and not connected to the control system. Opening can only be done when the full sector has been completely installed and baked. We will follow this work closely.

ADT:

- **System test and commissioning:** All kicker assemblies and their power supplies and drive chains have now been checked right through, one at a time, using the four completed amplifiers. All anode converters have been switched on and taken to 12 kV.
- **Layout and naming:** In cabling, the kicker control racks in UX45 and SR4 have not been assigned to the kicker/module assemblies in the way originally planned. In UX45 the rack sequence follows that of the machine layout convention rather than the functional sequence for B1 and B2. This caused some serious initial difficulties in the check-out. Corrected layouts of racks showing the names have been re-drawn. The equipment names on the racks will be changed accordingly, with minimum changes to the cabling.
- **Amplifier completion:** The Dubna team will return in June to complete the test; by this date all material should have been delivered. (only 8 resistors remain to be delivered)
- **Cooling water spares:** Cost of spare parts will be limited to CHF 12,000

Vacuum equipment:

- **Electron stoppers.** These are still in the central workshop but we understand that they are nearly ready.

- **APWL:** All cables have been connected

2. ACS Modules, Couplers and SM18

- **Module 4 (Europa):** The module is in the bunker, connected up, waiting for cryo.
- **Polar loop tests:** HV and RF will be switched on to prepare for tests on the voltage and phase feedbacks around the klystron.
- **Cavity 21:** Planned go into the bunker towards the end of June.

3. LLRF:

- **Series production & test of modules:** Around 100 VME modules have been delivered. A number of the series of 70 clock distribution modules have shown problems with the soldering of connections from the board to the front panel connectors. This will be taken up with the design office. The series tuner front-end modules will be tested soon. Testing of the tuner control modules is nearing completion.

4. ADT low level and diagnostics (Presentation by Daniel)

- **Layout:** Daniel showed the overall block diagram and explained how the system is split in the tunnel arcs, the controls racks in UX45 and in SR4.

Two separate PU signals are taken for each plane from the tunnel for each beam. Hybrids are used to derive sum and difference signals from the plate signals; these are filtered in the first processor module and passed to the position detector module. Each of the two position signals derived is taken to two loop controllers, each of which drives its own 1W pre-driver. The two pre-driver signals are taken to the UX45 racks where they are each split into 4 to drive two pairs of 200 W drivers, each driver pair feeding a 80 kW kicker power amplifier in push-pull. A Power Interlock Module (PIM) monitors and interlocks the DC power, one module for two power amplifiers.

Local (LF 250 Ms/s) acquisition systems monitor the 200 W driver outputs and the voltage divider signals from the power amplifiers. These signals are also taken to local multiplexers to return selected signals to fast acquisition systems in SR4.

Rack layouts are complete and all information needed to fully define the cabling now exists.

A number of other points were detailed:

- **PU connections in the arcs:** The patch panels above the quadrupoles Q7 and Q9 are installed and all the connecting cables to the pick-ups inside the quadrupoles are prepared. The Q7 PU is difficult to access, being at the back and very close to the QRL and a special connector has had to be made up. The HOM loads are cabled but are still to be installed and connected.
- **Cable length compensation:** Since the PU hybrids are in SR4 the PU electrode cable pairs need to be equalized. The stability of the cables has been tested by driving with a common signal and measuring phase variation over time. Stability is good to < 0.5 °, but even though the cables were cut to the same lengths there are differences that will need fixed compensation elsewhere in the system.
- **Phase differences between different amplifiers:** These need to be measured for each amplifier during commissioning and compensated. Drive cables from SR4 to the tunnel also need to be measured.
- **PU gain switching:** There is 26 dB between nominal and pilot intensity. Gain/attenuation settings will be changed depending on the machine mode. This can probably be done by the machine sequencer software, avoiding use of timing. (even for the pilot which precedes each first injection)
- **PIM modes:** The PIM allows power above the tetrode nominal power ratings for preset limited intervals to avoid switch-off during short transients. The final level settings and interval

settings will be determined during early operation. Repeated overpowering is also treated as a fault; after a certain number of occurrences power is switched off.

- **Power converter performance:** In view of issues raised with/by the manufacturer at the time of the order, the performance of the anode supplies will need to be thoroughly tested under real operating conditions.

5. AoB

- **Budget and CtC:** Latest estimates indicate that we are heading towards exceeding the RF CtC by 2.5 MCHF. We will need to look closely at all planned future expenditure and make a number of cuts.

Next Meeting: Thursday 24th May at 08:45 in the JBA room.

E. Ciapala, 23rd May 2007.