LHC RF Meeting
11th August 2006

Participants: Luca Arnaudon, Philippe Baudrenghien, Thomas Bohl, Andy Butterworth, Edmond Ciapala, Heiko Damerau, Wolfgang Höfle, Pierre Maesen, Elena Shaposhnikova, Joachim Tückmantel, Daniel Valuch, Frode Weierud.

1. UX45/RUX45 installation (All + info from Olivier)

The past week has seen good progress in the preparation for installation in RUX45/UX45 and also the start of installation of RF equipment in UX45.

- **UX45/RUX45 Floor painting:** Painting has been completed in RUX45 and UX45.
- **Floor marking and drilling:** SU will mark the beam lines, all equipment positions and IP4 centre in RUX45 next Monday (Aug 14th.). Floor drilling will be done just after.
- **Equipment installation in RUX45:**
  - Transport has been organized for ACS module 3 (ASIA) early next week. As floor drilling will still be going on it may have to remain in UX45 for a few days.
  - A klystron and a circulator will also be taken down next week.
  - The three remaining ACS modules can be taken down the two weeks following next week. (Weeks 34/35).
  - ADT kickers and APW monitors will all be taken down before September.
- **Survey in RUX45:** Will be done the first week in September (agreed with SU team)
- **Equipment Installation in UX45**
  - The HV junction box installation and cabling should be completed today
  - The four bunker control racks have been put into the bunkers; two have been successfully connected.
  - The 16 klystron control racks are being transported today.
  - Cavity wall mounted conditioning units. They will be brought down and fitted next week. Cables and connectors can then be completed.
  - Ethernet cabling is practically complete; the installation of network equipment is starting (AB CO)
- **SAFETY ISSUES**
  - 220v mains connection boxes, normally mounted on the bottom of the racks (ACS and ACN) had to be dismounted to allow fitting of earth lines on the racks. ST-EL have complained that this was done with the units still connected to the 220vac supply and the units were then left detached in the bottom of the rack. We are therefore reminded to obey a simple and obvious rule: always disconnect any equipment connected to the mains before any intervention and ensure that others to do the same.
  - The distribution box for lighting in the Faraday cages does not conform to CERN standards (colour coding). We are therefore required to change the cabling, or alternatively provide an attestation of conformity. **(Action: J-C Perrier)**

2. Special Topic: "The ACS RF Distribution Systems," by Daniel.

- See slides Daniel first outlined the scope of the system – i.e. the distribution of cavity, klystron and cavity HOM signals to a large number of 'users'. Over 900 passive RF devices are used in the system, with around 500 of these custom designed to optimise performance. Important design

considerations were minimising delays for critical signals, adjusting signal levels to keep overall dynamic range - taking cable attenuations into account, reducing the number of interconnections and reducing cable density in certain racks.

The design of the signal routing was done by Philippe, Daniel and Luca. The actual realisation was done mainly by Daniel.

The overall layout drawing (one cavity) shows the various parts of the system and how they are arranged in the various crates (green areas in the diagram)

- The cavity controller distribution chassis (one chassis per cavity in the Faraday cage). It provides the klystron output, cavity reflected and forward and cavity antenna signals to the cavity tuning and feedback systems. The klystron signals come via the klystron rack – see below. The system is set up to allow for up to 12 MV/m in the cavity and 2 MW power (for transients). Variable attenuators (coarse and fine setting) allow calibration of the antenna signal. Monitor points are provided. The system was designed such to have at least 50dB isolation between the signals of interest and the reflected signals from any end of the distribution fan-out. This will avoid perturbing the control loops for any potential bad termination of the cables, including short/open circuit. The antenna calibration attenuator, coaxial RF switch and the pre-driver amplifier are housed in the driver crate.

- The RF sum chassis (one per beam) takes each cavity signal via a variable attenuator, coarse cable delay and a mechanical delay in order to form the vector RF sum seen by each bunch. (This will be set up as closely as possible using instruments and calculated delays once RF is available, then possibly fine tuned later with beam). Coupled signals are also taken to the ACS racks for field level indication and interlock, and to the MUX for remote signal monitoring in SR4.

- The RF multiplexer (two chassis per beam). Eight signals per cavity are multiplexed and connected to the surface. These include: antenna, cavity forward and reflected power, klystron forward and reflected power, HOM wideband, HOM narrowband and a spare. The multiplexer is remotely controlled over Ethernet.

- Klystron / cavity power measurements (one chassis per klystron rack) This provides the measurements of klystron and cavity powers for interlocks, monitoring and diagnostics. Signals are taken via directional coupler from the waveguide system: klystron forward and reflected powers, cavity forward and reflected powers, also the reflected power at the circulator input and the reflected power at the circulator output. The latter are used for the Wattcher LO and Wattcher HI interlocks respectively. The detector and processing electronics provides analog signals for PLCs and LF diagnostic equipment and interlocks where needed.

- HOM Coupler signals One of the two outputs on each of the four HOM couplers of each cavity is simply taken to attenuating cables and loads on the klystron platform. The other four outputs are used for HOM power measurement, interlocks and observation. These are taken to 20dB/250W attenuators, specially designed to withstand power peaks, mounted on heat-sinks on top of the ACS racks. All four signals are filtered at 400 MHz to detect fundamental power, which is measured and interlocked. One narrowband and one wideband HOM signal are taken through non-filtered channels to measure the total power locally. The other narrowband and wideband signals are passed to the RF multiplexer for monitoring in SR4. The signal processing crates and the power measurement crates are housed in the ACS racks, one set serving for two cavities.

- Most of the crates are already completed and all patch panels are already in place in P4. Installation will be done in September/October and a program of measurements and checks will be done before RF power is switched on to the klystrons and cavities.

- The signal distribution system is clearly a crucial part of the ACS RF system. The excellent work put in to provide a reliable, coherent signal distribution system with best possible characteristics is an important contribution towards achieving successful high performance operation of the RF system.

Next Meeting: Friday **18th August** at 08:45 in the JBA room.

E. Ciapala, 17th August 2006.