LHC RF Meeting
18th March 2005

Present: Luca Arnaudon, Thomas Bohl, Olivier Brunner, Edmond Ciapala, Wolfgang Höfle, John Molendijk, Trevor Linnecar, Pierre Maesen, Elena Shapochnikova, Joachim Tückmantel, Daniel Valuch, Frode Weierud.

1. ADT (Wolfgang)

- **Integration of Tetrode Amplifiers:** We are assured by ST-IC that there is no problem for the fitting of these due to tunnel floor height irregularity. A survey of the tunnel around point 4 is planned in any case for the near future.
- **Anode Supplies:** The manufacturer's proposed key and interlock arrangement (master key releasing other door keys) seems unnecessarily complicated. In addition it will be necessary to allow specialist running of the supply with doors open. Floating connection of the negative pole has been done but this was only an option in the specification. These items, plus the lifting system, will be brought up at the next Imtech visit on 24th March.
- **Drive Amplifiers:** All 12 of the first batch will be accepted. Errors in the phase characteristic can be considered within spec. by including a certain fixed delay.

2. ACS Couplers and SA2 conditioning (from Eric)

- **Couplers for module 2:** Couplers MC116, 117 118 and 119 are conditioned and ready.
- **SA2 Conditioning:** Conditioning of couplers MC120 and 121 has started.

3. ACS Modules and SM18 (Pierre)

- **Module 3 conditioning:** Couplers of all cavities have reached 300 kW. Cavity D has been the most difficult. Nominal field has also been obtained in A, B and C.
- **Module 2:** has been closed, without the fitting of the second beam tube, due to non-availability of VA group support resulting from other priorities at this time. The operation will have to be done after RF power testing and conditioning.
- **He incidents - Soleil and Module 3:** These were brought up at the DSOC (Departmental Safety Officer's Commission) meeting of 16th March. The cryo systems in the bunker for both the Soleil module and the LHC module were presented by L. Serio. (See Diagrams). For the LHC modules no additional safety measures are needed but measures to reduce the likelihood of discharge are proposed. These are: the connection of safety valve outlets to balloons or the outside, changing the output valve from default closed to open with release to a balloon and use of a non-return check valve in the output line. A review of the Soliel dewar supply and its safety system would also be done before another Soleil module were installed. Non-transmission of the oxygen deficiency alarm in the first incident was due to non-connection of the alarm cable in SM18; for the second incident the alarm was still on test mode at the time.
- **Module 5:** Will go into the bunker next (from 1st. April) to check the tuning adjustment done on cavity B.

4. ACS Power (Olivier)

- **Klystrons:** Klystrons 15 and 16 are tested, klystron 17 will be delivered next.
- **HV Ripple:** Important reductions in noise and harmonics have been obtained by work on the power supply. A factor 3 reduction has been gained overall in 100/200 Hz components. The larger filter capacitor (2 => 4 uF) has given another factor 2 reduction. This has allowed another set of tests to be done on the modulator and divider combinations.

Noise measurements (Vcat, Vma and Vrf) were presented for 3 configurations (58 kV):

1. Standard AC heater supply on the tetrode, standard 5 MΩ resistor divider.
2. DC heater supply, 1.5 MΩ divider
3. DC heater, 5 MΩ divider.

For the same 5 MΩ divider (comparing 1 and 3) the DC supply (3) gives slightly lower ripple overall on Vma but more LF ripple (50 & 100 Hz) on Vcat. The RF in turn has less LF ripple but slightly more of the higher harmonics. Overall it appears only slightly better. The 1.5 MΩ divider (comparing 2 to 3) shows that for Vcat there is a very slight reduction in the LF components only, for Vma there is a general increase and for Vrf there is some improvement in the range 0 to 300 Hz but a very slight increase in the 600 Hz component.

Note that amplitude noise depends on the difference between Vcat and Vma, which explains the above. Phase noise however depends on Vcat. A measurement of phase noise may be worth re-doing.

5. Low Level RF (Philippe)

- **Faraday Cages:** The drawings were put into CDD (Direct approval by Trevor) and the IT has been sent out. The opening date is in six weeks (Late April).
- **RF Feedback Module:** A minor design change has been introduced to extend the range of the notch filter needed to compensate the resonance in the klystron output. (600kHz covering 404.8 to 405.6 MHz). The notch frequency has to be set individually for each klystron; the procedure will be part of the overall system set-up.
- **Fibre Optic Measurements:** The existing PS-SPS link has been measured and found to be noisy, compared to a 10 km roll of fibre. One problem is reflections, probably due to the large number of connections and patches. The noise appears to be less of a problem for high amplitude signals. For the CCC to SR4 link we need good noise performance. The routing will be chosen to give the minimum number of connections. Direct soldering of fibres can also be done.
- **Main RF Phase Loop:** The phase of each bunch is measured separately. A special band-pass filtering (ringing) system is under design. The bunch signals are then IQ demodulated with the RF frequency to get an amplitude-independent phase measurement, bunch by bunch. The values are stored and the overall average, or the average over given batches, can be obtained as needed depending on machine state. Modern low-noise amplifier design permits the use of a normal pick up rather than a resonant pick-up for the phase signal. If noise is a problem, e.g. for pilot or ion beams, we would use an additional AGC amplifier or do acquisition and processing locally, in UX45.
- **Trigger Units:** Work has started on the design of a VME 400 Mhz trigger unit (John + Greg). The question of changing the trigger settings by hardware (GM timing) or by software interrupt needs to be looked at for the different applications. (e.g. injection timing, diagnostics etc.)
- **Tuner Control:** The missing divider circuit has been received and mounted; this now allows checking of the on-board Post-Mortem and Observation memories.
- **One Turn Feedback:** The module uses a 1220 pin FPGA, this is needed due to the amount of gates needed rather than the I/O requirements. Allowing overflow to wider word sizes accounts for the large number of gates. The module will be the subject of a special FB Section presentation next week by V. Rossi.

6. RUX45 Layout Diagrams

- Drawing LHCLJ4GA0007 has now been to be updated and checked. It now has to be archived. The CDD approval procedure will be sufficient to make the layout official (rather than making an ECR). It will then be necessary to ensure that this and the machine layout drawings correspond

(Action: Volker + S. Chemli)

7. RUX45/UX45 installation (Olivier)

- **Civil engineering:** Construction of the shielding wall is still in progress, bunkers and platforms will start after Easter.
- **Grounding bars**: will be installed by ourselves, with FSU.
- **Cryo WRL**: We are following up on dimensions and valves with L. Serio. A final arrangement has to be prepared next week for integration. **(Action: Ed. Pierre)**

8. SR4 Racks layout (Luca)

Feedback on this is needed soon. Most systems have preliminary layouts that can be quickly updated and provided. (Controls, ADT, LLRF, Observation & Diagnostics). A layout has been done for ADT power racks outside the control area.

9. Beam Permit and machine protection (Andy)

- **RF Equipment protection:** A discussion was held with the machine protection team (R. Schmidt) on 'safe' levels for masking of RF system interlocks (See details LHC RF 4th. March). The machine safety level of 3.5 mA at 450 GeV is the damage threshold; the level for interlock inhibit could be brought closer to our 500 uA warm ACS safety level, giving a simple single overall level. It will be brought up in a future MPWG meeting.
- **Machine Protection Review:** Present priority for the MPWG is the machine protection review coming up in the next 3 weeks. Control of the damper and abort gap cleaning are issues.

10. AoB

- **RF Equipment in ISR:** Some improvements have been made in the arrangement of the remaining material. (Safety). We are expecting news soon on final disposal or storage elsewhere of this equipment.

Next Meeting: Friday 1st April at 08:45 in the JBA Room 864-2-B14.

E. Ciapala, 23rd March 2005.