LHC RF Meeting 24th September 2003

Present: Luca Arnaudon, Philippe Baudrenghien, Olivier Brunner, Andy Butterworth, Edmond Ciapala, Roberto Losito, Eric Montesinos, Trevor Linnecar, Volker Rödel, Joachim Tückmantel, Daniel Valuch.

Excused/Absent: Thomas Bohl, Elena Chapochnikova, Wolfgang Höfle.

Agenda:

- 1) SM18 ACS Modules status (Roberto)
 - Klystron equipment tests (Olivier)
- 2) P4 Integration:
 - Status and review of outstanding items in tunnel area (Volker)
- 3) Other follow-up from last meeting
- 4) Tests on directional couplers and splitters (Daniel)
- 5) Round Table / AoB

1) SM18 Modules, Couplers, ACN Cavities, Klystron power tests.

• ACS Modules status (Roberto) After fitting of the four couplers, module 3 has been leak tested and is OK. Bake-out of the couplers will now be done. The module will be installed and in the bunker and cooled down ready for RF tests by 10th October. Module 1 is having the second beam tube fitted and will be cooled and frequency tested. Module 2 (with 80 kHz error in one cavity) will have all cavities re-adjusted. Module 5 is ready to go through thermal cycling.

• **Power Couplers:** (Eric) Ceramics for the next set of four couplers have been oven-tested and the couplers will be assembled, baked and tested over the next 2-3 weeks. Tests on the improved brazing method for the second ceramic have been temporarily interrupted but a sufficient number of fully tested second ceramics is available to allow the completion of these four couplers.

• ACN Cavities: (Roberto) Some cavities have resisted the normal de-oxidizing process and will need further treatment. Cavities 7 and 8 will be measured at the manufacturer's in October and delivered in November if all goes well.

• .Klystron tests in SM18: (Olivier) The power system is fully operational for module test and conditioning. The circulator temperature compensation system supplied with the circulator has given problems and suffers from limited remote diagnostic facilities. Modifications will be needed for UX45 operation and these are being studied.

(Action: Olivier, Luca).

2) Integration (Volker)

A comprehensive review of the present situation was presented:

• Ventilation in tunnel area: The passing of the inlet ducts along the chicanes has been <u>re-rejected</u> by the Integration Working Group, as too much space would be taken up in the passages. The passing of duct through the roof would probably require shielding around the duct entry. This is being investigated by TIS. The duct passages are just above the spaces between the R1 and R2 ACS modules. We do not expect a significant increase in the high energy radiation reaching the LLRF racks because of this hole in the roof.

• Ventilation units above klystrons in UX45. The platform has been finalized

• Doors for ventilation in tunnel area: Doors will be put between ACN and ADT on either side of the IR, to seal the volume cooled by the roof mounted units. The proposed construction of the doors has to be checked (Action: Volker)

• UPS in UX45: UPS will be situated next to the UX45 control racks, near PZ45. These could also supply the LLRF racks on the other side, avoiding the need for UPS in the cryo area.

• **Platform for LLRF racks:** The design has been accepted by the Integration Working Group. The platform is not in our EVM budget estimates.

• **HV cables:** Space has to be found for the 10 junction boxes to connect existing cables from the five (four plus spare) klystron Power Converters to the extra cable lengths to the HV bunkers. Details such as allowed oil quantities (50 l maximum) and spacing between the boxes have to be agreed with TIS.

• **HV Bunkers:** Specs have to be completed by the end of the year. Construction will be in July 2004. The system for cooling and ventilation in the bunkers has to be studied, together with smoke detection and fire safety requirements.

(Action: Olivier with J-C. Perrier and G. Pecheur) • Dust Traps: (Joachim) A design study for four dust-traps, to protect the SC cavities from graphite particles from the collimator system, has been initiated with BT group. These relatively short devices would be put next to the ADT. DC Power supplies and controls would be put in the RF racks in UX45.

• **APW:** A short functional specification, based on the present design plus any additional information from the ongoing tests, should be produced for the integration WG.

(Action: Thomas with Volker)

• Crash barriers for ACS & ADT: Still under study.

• ADT Cooling water: Also ongoing.

• Warm Recovery Line: Integration with the rough layout given is not straightforward (Mainly due to the heaters). A definitive proposal should therefore be prepared and agreed, before integration studies continue. (Action: Roberto, Ed with L. Serio)

• Radiation Stoppers: VA group has prepared a draft ECR <u>LHC-V-EC-0002</u>. Some questions arise: energy of electrons, Interlocks, closing valves for He Processing. The ECR should be checked and corrected where necessary. Comments should be in EDMS by 2^{nd} October. (Action: Trevor, Roberto, Joachim, Volker, Ed.)

• UX45 Earthing: This has been re-discussed with J. Pedersen. For the klystrons possible solutions are either a direct cable from each klystron to its HV bunker, in turn connected to an earth bar, or grouping the klystrons by fours using an earth bar connected by single cables to the bunkers. J. Pedersen has offered to do a layout based in this option. This should be followed up. (Action: Olivier)

Cable trays all have earth lines.

• HOM Coupler protection for SC cavities: C. Ruivet is preparing a design.

3) Other follow-up from last meeting

• **Radiation studies** (Andy) In considering the figures of 0.04 failures per device per year the relatively poor vacuum assumed in the SC cavities and the safety factor included have to be considered. On the other hand, the actual numbers of FPGAs which will be used per cavity may be up to 10. However some devices will be smaller than that taken for the estimates and furthermore not all cell failures necessarily produce a system fault.

The <u>conclusions of the last meeting</u> (Section 3) remain valid; however it would be worth while to obtain data for the case of situating the equipment on other side of the shielding wall.

(Action: Andy)

So far tests and measurements around the klystron in SM18 have shown no signs of RF leakage.

• Soleil: A review of the controls work in SM18 has been started by Luca. This also includes the options for the second (350 MHz) bunker where the module would be run. A proposal will be prepared in CS section. (Action Luca, Roberto, Ed.)

4) Tests on directional couplers and splitters (Daniel). Measurement results were presented. While already acceptable the coupling and impedance of the -20 dB coupler can be further improved using a resulting better estimate of epsilon. The -10 dB coupler has less constant directivity over the frequency range of interest, but is more than adequate for power

measurement applications around the klystron and waveguides. The splitters have adequate isolation between outputs, mis-termination of the other outputs producing a maximum of a few degrees phase variation in the output signal.

5) AoB/Round Table

• **Software** (Andy) A list of our milestones and delivery dates for controls group equipment and software has been established with Axel Daneels. Important details such as availability of front-ends and software for PLCs and LLRF VME systems are defined. A planning will be produced. Additionally, for the LLRF VME developments, collaboration has started with Alain Gagnaire (AB-CO-FC) on provision of basic hardware test facilities (first stage) and on providing the functional interface to application programs (second stage).

• **EVM** (Ed) We should now consider the system fixed, with a minimum number of changes to work units. These are now sent to project hierarchy and group leaders. Staff manpower estimates may be entered into the system in the future (Trevor).

Next Meeting:

(Provisionally) Wednesday 8th October 2003

E. Ciapala, 25th September 2003