LHC RF Meeting 3rd September 2004

Present: Luca Arnaudon, Olivier Brunner, Philippe Baudrenghien, Andy Butterworth, Edmond Ciapala, Wolfgang Höfle, Trevor Linnecar, Joachim Tückmantel, Daniel Valuch, FrodeWeierud.

1. ADT Status (Wolfgang)

• **B867 Test area:** A clean out of the area is in progress. Work on electricity and water needs to be followed up with TS. C. Julie (SR section) is responsible.

• Anode supplies: An indication of the cost of 12-pulse version has been given by the supplier. Legal aspects of proceeding with this are being looked at. With the 6-pulse solution some operational constraints will be imposed. The main need for high power is for q-measurement kicking. The limiting operating conditions can be estimated (worst case) but the exact levels will probably only be revealed after tests on the final installation. There is, in any case, no danger to the power supplies themselves. A technical discussion will be held shortly with AB-PO.

• SPS Anode Supplies tests: While full power cannot be drawn, due to interlock protection on pulsed current, some interesting results were obtained. Pulsing near the 50 Hz harmonics gives rise to large ripple components at the difference frequencies – e.g. at 294 Hz a 10 % ripple is seen at 6 Hz. With two dampers being pulsed perturbation can be seen on the third.

• **SR4 transformers:** The only other equipment on the anode converter transformers is the screen and control grid power supplies, which by their design should not be affected. Other equipment will be on UPS.

• Feedthroughs: It has been decided to use blowers to prevent humidity problems. Existing standard blowers may be over-dimensioned, but some recently found spares are available in case they could be used (Olivier & Roberto). There is a stores shortage of the mounting flanges for the feedthroughs.

• **Kickers:** The Russian 304L steel test chamber is being tested by AT-VA. The tests will not be completed till week 38 but so far they look successful (normal water content in spectrum - bakeout was done at JINR). Specialists in the central workshops will also inspect the welding. Following this we expect to obtain rapid approval for the use of the Russian 304L steel. Due to the available material stock, the wall thickness of the tanks may have to be reduced slightly; it is however expected to remain well within acceptable limits.

• Amplifiers: We are still waiting on some components. A batch of CERN standard flexible tubes for cooling water has recently been found to have electrical conductivity and must not be used. It seems we are not affected.

• **HV capacitors:** Simulations by R. Louwerse have shown that extra HF filtering may be needed on the HV supply to the amplifiers. This means that capacitors (20 uF) will probably have to be installed in the tunnel. (Placing them in the klystron gallery is possible but this would mean extra cables and junction boxes). This also needs to be followed up in the integration studies. (Action: Volker)

• Water cooled resistors: Two samples of the new resistor (industrially manufactured) will be DC tested at 12 kV at Dubna, once the HV area is re-commissioned after a cooling water upgrade.

• Low Level: The design will be based on a new common approach for a number of CERN wide transverse damper applications. V. Rossi will start work shortly on the design.

2. Installation and Planning: (Olivier)

• Water: TS-CV (R. Principe) has finalized the design of the UX45 cooling systems. Solutions for different installation scenarios have been found: e.g. installing before UX45 bunkers.

• **QRL installation:** A solution allowing CE installation work in UX45 before completion of the QRL has been found. The shielding wall would initially be constructed with openings allowing passage of material and access to the cryo lines for assembly and welding; these openings would then be filled in after QRL completion.

• **Faraday cages in UX45:** Installation remains planned for the end of 2005. A solution has been found for installing cable trays without causing interference to the assembly of the cages.

• Cabling: J-C Perrier will discuss cabling and its planning with J-C Guillaume.

• Machine Tunnel (RUX45): Here the planning follows the general installation planning. We should follow up evolution of key dates for installation of RF equipment.

• UX45 Planning: The H. Gaillard planning should be put on the RF installation web page where it can be updated whenever necessary. (Action: Olivier/Luca)

• **QRL and General Planning:** A high-level meeting will be held soon to approve the contractor's proposals, which should lead to an updated general installation planning.

3. Couplers (Ed on behalf of Eric)

• **Conditioning in SA2:** Conditioning of couplers MC111 and 112 has now passed 300 kW continuous. They will be kept powered till the next pair of couplers is ready.

4. SM18 and modules (Pierre)

• **Module 1:** has had its couplers fitted and baked out. The module has been successfully leak tested and is now being installed in the bunker. The radiation stopper will be fitted in the coming week, waveguides mounted and the module cooled down. Low power measurements will be done first.

• Antenna cables: These will be checked and calibrated.

5. ACS Power (Olivier)

• Klystrons, loads & circulators: Klystron10 will be tested this coming week.

• Klystron ripple: A number of tests were done in Hall 112, SM18 and A5 during the week.

• Measured amplitude ripple: Another factor (in addition to mod anode ripple) contributing to measurement of over twice (5.4 % compared to 1.7 %) that expected from the theoretical formula* can be due to the fact that it does not take into account the change in beam current also produced by voltage change.

* (See <u>Review of LHC Klystrons</u> presented at the HRF meeting of 25th March 2002)

• Tests with an HV generator in A5: These showed no 100 Hz on the modulator, confirming that 100 Hz is entirely due to ripple on the power converter.

• Reduction of 50 Hz on the klystron modulator: This can be achieved by trimming the position of the HV connection to the tetrode heater. However, the optimum point depends on the working point (I and V) of the klystron.

• Compensation of power supply ripple via the modulator: This is complicated by voltage divider and cable capacitance which introduce a low pass filter. It could only be effective for amplitude modulation, since phase modulation is produced by variation in beam velocity, which is only dependent on HV and not on the modulator voltage.

• **Replacement of modulator with a fixed divider:** Operationally this would be acceptable for LHC operation, since the collector can take full DC power with no RF and klystron efficiency is not a major concern. It was originally agreed to follow the present approach, using the tetrode modulator, since the hardware was available from LEP and it could allow some flexibility. Some improvement in reliability might however be achieved, without the HV tetrode and the control electronics in the oil tank.

• Waveguide recuperation in ISR: LHC waveguides (half-height) are now being sorted out in preparation for transport and storage in the tent used for the LEP klystrons. At the same time the large amount of waveguides for Linac 4 will be sorted and taken to storage near the PS. Official confirmation is still needed before waveguides for other institutes are moved. Quick agreement would avoid intermediate storage outside the ISR, when the ISR space has to be cleared.

6. Signal and Timing Distribution over fibres (Philippe): We now have to decide on transmission equipment for signals to be sent over fibres. The first priority is for timing signals from SR4 to BA3. While most analog signals will be acquired and digitized locally for transmission over the

controls network, a number of fibres have been allowed for direct transmission of signals. We have the choice of treating the two applications separately and going for commercial solutions, or developing a common VME based system onto which the appropriate lasers can be fitted, depending on the application.

7. **SR4 Layout:** Some of the equipment stored in SR4 has been removed (AB-PO) and installation of racks can be started. J-C Perrier will collect and re-confirm the RF system rack requirements in the whole building, to allow installation, shifting and removal of racks as necessary.

8. RUX45 Integration: As mentioned above, space may need to be found for HV capacitors for the dampers. He warm recovery lines, vent line connections and emergency outlets to the roof still remain to be finalized. (Action: Volker, Ed, Wolfgang)

9. EVM: The overall schedule variance which still remains overall is largely due the fact that at present, simply having changed the expected starting date and not the actual starting date, as we have done for a number of more expensive items, does not readjusted the planned value profile. This anomaly will be changed by the EVM team. The methods of estimating and splitting cabling costs are still unclear, these costs account for 0.5 MCHF variance.

Next Meeting: Friday 17th September at 08:45 in the JBA Room 864-2-B14

E. Ciapala, 14th. September 2004