# LHC RF Meeting
4th March 2005

**Present:** Luca Arnaudon, Thomas Bohl, Olivier Brunner, Andy Butterworth, Edmond Ciapala, Pierre Maesen, Eric Montesinos, John Molendijk, Trevor Linnecar, Joachim Tückmantel, Daniel Valuch, Frode Weierud.

## 1. ACS Couplers, SA2 and conditioning (Eric)

- **SA2 Conditioning:** Conditioning of couplers MC118 and 119 is complete (300 kW cw). They will then be fitted to module 2 together with already completed 116 and 117.
- **Couplers MC120 and 121**: Are being mounted on the test cavity.

## 2. ACS Modules and SM18 (Pierre)

- **Second He incident - Module 3 :** A water cooling problem for the SM18 cryoplant has again resulted in overpressure in the helium return line and He discharge through the module valves (2 bar) into the bunker (again closed at the time). Again the Oxygen ODH alarm did not reach the fire service. The cryogenics operator was present to close the valve this time and the losses were limited to the helium in the module. The pressure reading reached the 2 bar reading limit of the gauge. On restarting the cool-down there was an alarmingly high beam vacuum reading at the beginning; this was probably due only to warm gas being circulated in the cavity causing out-gassing from the cavity surface. Note that while the module rupture discs are connected outside the bunker, the valves open into the bunker, a situation accepted by TIS/CS. The non-transmission of the automatic alarm needs to be followed up, although it is not our direct responsibility. The occurrence of two such incidents recently is of concern. Trevor has to be informed of any further developments or feedback from SC. (Safety Commission)
- **Module 3:** There was no change in frequency, at least on cavity A, following the overpressure incident. Conditioning has now just started. Some field has been put in the cavity with the coupler already at 30 mm.
- **Cavity Tuning:** The tuning of cavity B on module 5 has been adjusted. 0.6 mm spacing has been removed to give an expected decrease of 60 kHz in the lower frequency. Removal of this spacing did not significantly alter the frequency of the cavity at the relaxed position, indicating that the 0.8 mm spacing introduced previously has since been taken up somewhere. (by cavity stretching?). Frequency range and frequency vs. tuner position and displacement will be measured on this cavity next week. Module 2, the next planned for the bunker, has only one cavity (D) needing only slight adjustment. 0.3 mm has been removed to check that we are on the right track. If possible, we will put module 5 in the bunker to recheck tuning of cavity B when module 3 is finished.
- **Second bunker:** fitting of the electronics for cool down in the second bunker is probably needed; this has to be fitted into Luca's work list.

## 3. ADT (Frode)

- **Anode Supplies:** The lifting support system is being discussed with the supplier.
- **Dubna:** Eric and Wolfgang will visit next week. Important issues are the planned production of the kickers, assembly deadlines for the tetrode amplifiers and exact dimensions of the amplifier units.

## 4. B867 Test Stand (Eric)

- **Water:** The water cooling will be installed in the coming 2 weeks.
- **Electricity:** TS-EL is installing the power connection points. The remainder of the work will be done by our FSU teams. It will take 1-2 months.
- **Controls:** The general definition for ADT is progressing well. The B867 control system will correspond to one half that of an ADT 'module'. The layout will be finalized and cabling lists made, so that controls cabling can be done immediately after the electrical installation.

## 5. Low Level RF – Tuner Control (John)

John presented the design of the ACS Cavity Tuner Control module. There are 4 channels, cavity antenna, cavity forward power, klystron output power and cavity reflected power. Each of the 400 MHz RF signals is sampled at 80 MHz in the separate Tuner Front End module. 14-bit parallel data is passed via special flat cables to the Tuner Control Module; streamed in as sequential I+, Q+, I- and Q- samples in a 20 MHz cycle, giving a sampling rate for I and Q streams of 40 MHz. The alternate +/- sampling removes any offsets in the sampling process. (See figure IQ Demodulation). A phase rotator inserts a fixed phase offset, i.e. the 'tuning phase setpoint' into the data. A second phase rotator is provided for pre-compensation of the tuning just before the injection of first beam. A LP decimating filter stage provides the first stage of filtering while still retaining the signal values inside and outside the abort gap needed for half-detuning. The power product of the antenna signal and its cross products with the other three reference signals are calculated giving the antenna power for normalization purposes and the error signals used for tuning the cavity. There is a further filter stage before data is transferred to the tuning DSP. The normalization of the error signals can be done in the DSP. First measurements indicate a very high degree of stability – to 1/100 of a degree. The conversion offset, removed in the sampling process, brings only a slight reduction in the overall allowed signal dynamic range and is not a concern.

## 6. ACS Cryo System (Ed)

Following the meeting with AT-CR on 18th February and subsequent feedback:

1) We will have the warm recovery line connected to two cavities per module.

2) A rupture disc (~ 2bar, the exact value to be decided) will be mounted with valves on the other two cavities. Dimensioning to be done by AT-CR (L. Serio)

3) The rupture disc can be relatively easily routed to the space between the tunnel and shielding walls. However it may be that we are allowed to discharge into the tunnel (via suitable pipe & funnel) – to be checked with SC-GS. (R. Trant).

4) The variable return valve and check valve are the responsibility of ACR. They will calculate dimensions.

The above points have to be followed up as quickly as possible. **(Action: Ed)**

## 7. Beam Permit Interlocks for RF (Andy)

- ACS input to the beam permit can be divided into to RF power and helium interlocks. Below the machine safe limit (3.5 mA at 450 GeV) we can safely mask RF power interlocks. However if the ACS modules are warm the risk due to heating of the cavity exists well below this level (e.g. melting of super-insulation at 80 °C). An estimate of heating in a warm cavity has been made by Joachim - Warm Superconducting 400 MHz Cavities. The calculations show that dissipation of 1 W in the cavity results from a beam current of 500 uA and this causes temperature to rise at the rate of 0.3 °C per hour. This is probably a safe level as any tendency towards serious overheating would be observable before any damage occurred, via logging and alarms. (Note that the heating goes as the square of the beam intensity, hence 3.5 mA would give 15 °C per hour). We would therefore only run below the 500 uA level with Helium interlocks disabled. Above it He pressure and level interlocks must be active. The alternative would be to decide that He interlocks must be unmaskable at all intensities, hence no pilot beam (10 uA) allowed without cavities cold.
- For the moment we would not send pre-emptive RF trip interlocks to the beam permit.
- ADT interlocks, if any, have to be agreed.

A meeting will be organized with the machine protection team (R. Schmidt) to decide on the above.

**(Action: Andy)**

## 8. Access system, Valves and Stoppers etc.

Points brought up at the last meeting after report on discussion with Ghislain Roy on the use of electron stoppers in RUX45 as access safety blocks:

- **Dust and reliability - Sector valves.** Following communication from M. Jimenez, from LEP experience, there is no problem with dust from opening and closing sector valves near SC cavities. The design of the proposed electron stopper is not vacuum tight, hence the dust risk is even less.
- **Opening and closing of Sector Valves**. The sector valves must always be closed in the area in which access is given. They are not closed for access in other areas. The electron stoppers however would be put in if there is access in the neighbouring zones in LSS4 when RF test is on.
- **Access safety blocks:** We would strongly prefer the electron stoppers next to the cavities not to be used for this function. If ever there was of failure of the beam dump and no switch off of the D4 magnets at lower than nominal intensities, we could avoid destruction of the cavities if the access safety blocks were far away from the cavities.

These points will be brought up with Ghislain next week.

**Next Meeting:** Friday 11th March at 08:45 in the JBA Room 864-2-B14.

E. Ciapala, 8th March 2005.