

Meeting on Planning Organization for the 400 MHz LHC RF system
(ACS)
4th September 2002

Present:

Luca Arnaudon, Philippe Baudrenghien, Thomas Bohl, Olivier Brunner, Edmond Ciapala, Trevor Linnecar, Eric Montesinos, Joachim Tückmantel.

Absent due to vacation: Volker Rodel, Roberto Losito,

Proposed Agenda:

- 1) Review of overall planning, ACS milestones and planning
- 2) Planning status for the various systems e.g.
 - Cavities*
 - Infrastructure*
 - Power Couplers (Eric)
 - RF Power (Olivier)
 - Low level RF (Philippe)
 - Controls & interface (Luca)
- 3) Coordination and follow up, EVM implementation.
- 4) Outstanding/missing items (All)

1) This follows the overall planning by Volker and Trevor made earlier this year. A list of milestones (and constraints) directly concerning ACS was presented, also containing some others specific to the ACS itself.

2) ***SC cavity module completion*** (Ed, based on info from Roberto) Vacuum tests are being done on the modified second beam tube. If successful the tubes should all be fitted by the end of the year. When couplers are available these can be fitted (2 weeks clean room per module) followed by two months per module power tests and conditioning. Quench valves and He level gauges should be procured and fitted during 2003. A number cryo issues remain to be resolved. (Inlet valves, QV, PCV, Dynamic operating conditions-response, peak pressure)

Power Couplers (Eric) Tests on the fabrication of copper ceramic seals are ongoing and look promising. Kovar seals are being tested at high power (pulsed) up to 2 MW, so far without arcing. This will be pushed to the maximum. A deadline, end 2002, has been set for the final decision on which version to use for series production, after which the series production of ceramics will start. There is a strong interest in the copper seal version due to the much lower likelihood of contact problems occurring after several years of operation under high power. Eric presented a planning. Ceramics will be purchased from outside and the sealing rings mounted by industry + CERN, starting early 2003. Fabrication of a pair of ceramics takes 8 weeks. All other parts for construction of 25 couplers are already at CERN. The choice of ceramic seal type will only have a minor influence on production, i.e. on the machining of just one component. Assembly and conditioning of each pair of couplers takes 4 months, the series starting in mid 2003 and continuing through to the end of Q1 2005.

RF power (Olivier)

Series production of klystrons, circulators and loads. Problems were encountered with the series production prototype klystron, “scallop” of the beam causing loss of electrons into the wall of the drift tube before the output cavity with consequent heating of the tube and loss of RF power. A redesign of the gun will be made for the next klystron. This should also eliminate the need for the higher focusing current. The klystron characteristics have been measured and the response with the power spectrum that will be produced by the feedback

systems is satisfactory. The prototype load has been returned to the manufacturer after the detachment of some ferrite pieces and is expected to return end October/beginning November. Tests on the circulator are partially done but need the load for completion. While the delivery schedule for klystron, circulators and loads is now different from that originally planned, it remains to be seen whether or not the final delivery and end of contract dates will change. After acceptance tests modules, each consisting of klystron, circulator, load, auxiliary equipment and electronics will be assembled and tested, ready for installation.

HV equipment. A large part of the HV equipment is being recuperated from LEP, with the necessary modification in progress. The klystron modulators will be controlled in two modes, either with fixed HV dividers or by tetrodes, fixed mode not requiring powering of the tetrode. The final choice of component values depends on the final klystron characteristics. The prototype of the remote controlled klystron HV commutator has been successfully tested. Final layout and specification for HV cables and HV connector boxes in UX45 still need to be done. The HV equipment grounding arrangement in UX45 is under study.

Waveguide system. Again much will be recuperated from LEP - straights, E-bends and flexibles. A large number of H-bends will have to be ordered. A detailed waveguide layout plan has been prepared for each klystron in order that a parts list can be compiled. While numbers and positioning of directional couplers and arc detectors are well defined around the klystrons and cavities, requirements for other parts of the waveguide system still need to be determined.

Low level RF system. (Philippe) A summary planning and a basic block diagram were shown. Principal elements are the fast feedback, tuning loop, one turn feedback and klystron linearisation loops. The requirements for the latter are not clearly defined and a study needs to be done based on the characteristics of the power elements, together with tests in H112 and later on in the SM18 "test chain". Hardware for the tuning system is included in the controls planning, with the exception for the moment of the RF phase detector, which would come from beam control. The behaviour of the power system and its components under fast high power pulsing, as will be produced by the feedbacks, must be studied. We will have to establish to what extent transients exceeding normal ratings are likely to occur in various parts of the system and where so to design interlock and protection circuits such that unnecessary switch off is avoided. The detailed design of the low level system is now commencing. An important milestone for completion of a prototype system would be shortly after the installation of the SM18 "Test Chain" (see below) After a few months of validation and testing series production of the low level equipment would begin. The transient behaviour should be known and corresponding interlock solutions must be implemented before loop tests in the SM18 chain.

SM 18 chain planning The test of a full klystron cavity chain, together with all equipment and infrastructure as close as possible to the tunnel system, is planned from beginning 2004 to end 2005. Its purpose is not only to verify the characteristics and performance of the system and to find any unexpected difficulties before UX45 installation, but also to validate all critical equipment and electronics before series production. Space and helium supply must be maintained in SM18. Possible conflict with the end of cavity module conditioning may need to be resolved. A planning of all the activities is needed.

Controls Equipment (Luca) The equipment is fairly well defined and for many items prototypes are well advanced. Detailed planning for all items is in progress. The overall structure of the interlock system has still to be finalized. A final agreement on choice of RF hardware for the RF power / voltage detector is needed. As for the low level RF equipment prototype equipment must be ready for the SM18 test and series production started after a period of validation. Some basic equipment (e.g. temperature conditioning modules) is needed before in other test stands or for assembling other equipment and prototyping and series production for these must follow earlier planning and deadlines.

Software, Diagnostics and Post-Mortem A preliminary planning for these items has been made.

Infrastructure UX45 layout is now decided. A great deal of work now has to be done involving many parties. Water cooling around the klystrons has been fixed with CV. (This will come from the RF budget). Although cabling estimates have been done in detail the final cable lists via the “Demande Installation Cables” have to be made. Upgrade of layout for the new scenario of RF electronics on the cryo side of UX45 is needed.

Summary of some ‘key’ items needing special follow up:

- Cryo issues (see previous notes)
- Study and tests of power equipment for klystron linearisation electronics specs
- Power system behaviour with transients, requirements on interlocks
- Positioning and numbers of arc detectors and directional couplers in waveguides
- UX45 earthing
- SM18 chain planning – Helium supply and space allocation to confirm.
- RF detector hardware for signal and power measurement
- Electronics arrangement in UX45
- Detailed cabling lists and “Demande Installation Cablage”

E. Ciapala, 6th September 2002